Greater Yellowstone Network

Vertebrate and Vascular Plant Inventory

Study Plan

December 1, 2000

"A science of land health needs, first of all, a base datum of normality, a picture of how healthy land maintains itself as an organism" - Aldo Leopold

GREATER YELLOWSTONE NETWORK

VERTEBRATE AND VASCULAR PLANT INVENTORY STUDY PLAN

DECEMBER 1, 2000

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PROJECT TITLE:

BIOLOGICAL INVENTORY OF VASCULAR PLANTS AND VERTEBRATES IN THE GREATER YELLOWSTONE NETWORK PARKS: BIGHORN CANYON NRA, GRAND TETON NP, AND YELLOWSTONE NP.

TARGET FUNDING SOURCE: NPS – INVENTORY AND MONITORING PROGRAMS

Project Management Information System (PMIS) Number: (TBD)

FUNDING STATUS:

FUNDED FY00/01: $62,000 UNFUNDED FY01-04: $835,400

Acknowledgments

This plan was produced by the Greater Yellowstone Network Steering Committee, consisting of Mary Hektner, Martina Keil, Dr. Glenn Plumb, Mason Reid, Ann Rodman, and Dr. Kathy Tonnessen. Kevin Schneider edited the plan.

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I. INTRODUCTION

GREATER YELLOWSTONE NETWORK BACKGROUND

The Greater Yellowstone Area is recognized as one of the largest, relatively intact natural areas in the lower-48 states. Comprising some 18 million acres, Greater Yellowstone lies within the states of Wyoming, Montana, and Idaho, and encompasses six national forests, three national wildlife refuges, as well as state, county, and private lands. At the heart of this wild ecosystem lie Yellowstone and Grand Teton national parks.

A range of habitat types and elevation gradients within Greater Yellowstone create a richness of biological diversity. Sagebrush, lodgepole pine forest, and lowland and alpine meadows are but a few of the ecosystem's vegetative communities. Greater Yellowstone is one of only two places in the continental United States where stable grizzly bear populations exist. It is the only U.S. wintering ground for trumpeter swans, and hosts the largest elk herd in all of North America. Bison, the icon of the American West, range freely across the landscape here.

Although Greater Yellowstone appears to be relatively large and undisturbed, it faces seemingly unlimited threats in almost every direction. As one of the nation's most desirable places to live, development is quickly consuming areas that were undisturbed only five years ago. Habitat fragmentation is a concern, especially for species that need large areas relatively free from human influence, such as the grizzly bear and wolf. Teton County, Wyoming, for instance, is one of the fastest growing areas in the nation, putting pressure on resources such as air quality, night skies, and natural quiet. At least six fish species, some 20 bird species, and 18 species of mammals are considered rare, threatened, endangered, or of special concern.

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Each of the agencies managing land within the GYA has a different mission with different goals. Recognizing that coordination is essential amongst the agencies, the National Park Service and the U.S. Forest Service formed the Greater Yellowstone Coordinating Committee (GYCC) to facilitate management across administrative boundaries. The GYCC consists of the superintendents of the two national parks, the forest supervisors of six national forests, and regional Forest Service and National Park Service officials. Although the GYCC does not impose decisions, it helps identify and resolve any communication gaps between the parks

and forests, and it facilitates a coordinated management strategy.
Most ecologists generally do not locate Bighorn Canyon National Recreation Area within the boundaries of the GYA, however it is considered part of the Greater Yellowstone Network for the purposes of this study plan because of its close proximity to the other parks and enough similar species and habitat types exists that study designs will be similar among the three network parks. Bighorn Canyon expands on the communities present in the GYA by including juniper/mountain mahogany woodlands, desert shrublands, and riparian ecosystems.

ROLE AND FUNCTION

The Greater Yellowstone Network has organized its biological inventory effort to include two major functional components:

1. Greater Yellowstone Network Inventory Steering Committee
2. Inventory Coordinator/Data Manager

Greater Yellowstone Network Inventory Steering Committee

This group includes a member from each of the three park units, with the chair

The Greater Yellowstone Network

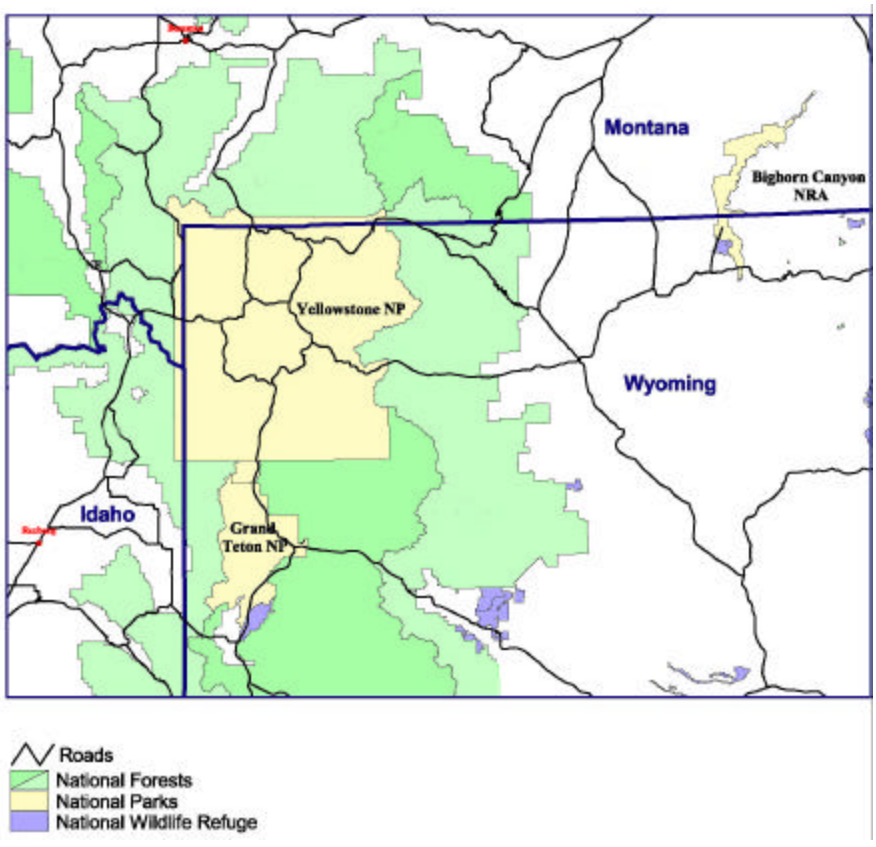

Figure 1

The acronyms used by parks in the Greater Yellowstone Network are:

BICA:	***Bighorn Canyon National Recreation Area***
GRTE:	***Grand Teton National Park***
YELL:	***Yellowstone National Park***
GYN:	***Greater Yellowstone Network***

representing the Rocky Mountains CESU (see Figure 2). The direct-line supervisor of the inventory coordinator also sits on the steering committee. The steering committee is responsible for writing the inventory study plan, hiring the inventory coordinator, approving the annual work plan for the biological inventory effort, and setting performance standards for the inventory coordinator. GYN annual work plans will also be subject to review by park management, the NPS Inventory and Monitoring Program in Fort Collins, and outside science advisory groups (such as academic, NPS, and USGS scientists) on an as needed basis. This oversight of the inventory program will be effected through regular conference calls between the steering committee and the inventory coordinator and through review of study plans and products by the steering committee. It is also the responsibility of the steering committee to expedite the work of the inventory coordinator and the inventory project investigators while they work in the park units. Committee members will also assist with leveraging and coordination of inventory projects with other park and regional natural resource projects. The steering committee will also guide future aspects of the GYN inventory program, such as planning for ecological indicators monitoring.

Inventory Coordinator/Data Manager

Dr. J. Lane Cameron was hired in December 2000 as a GS-11, 401-biologist, with a term appointment not to exceed four years. He will enter on duty in early January 2001. The incumbent was selected by the steering committee, and will be duty stationed at Yellowstone National Park in Mammoth Hot Springs. The coordinator will be responsible for gathering and organizing existing biological inventory data, planning and executing the biological inventory study plan as approved by the NPS Inventory and Monitoring Program, supervising biological technicians working on network data management, executing agreements and contracts for funded projects, leveraging additional projects related to biological inventories, and providing regular program updates to the steering committee, park management, and the Inventory and Monitoring Program. The coordinator is responsible for soliciting peer reviews of study designs and final products funded under the inventory project. The coordinator will be the principal data manager for new datasets, and will assure new inventory datasets are entered into NPSpecies and the Dataset Catalog, with the appropriate documentation and voucher specimen archiving. The coordinator will assist with the transition of the biological inventory project to development of long- term monitoring protocols for the GYN.

Greater Yellowstone Network Biological Inventory Conceptual Structure

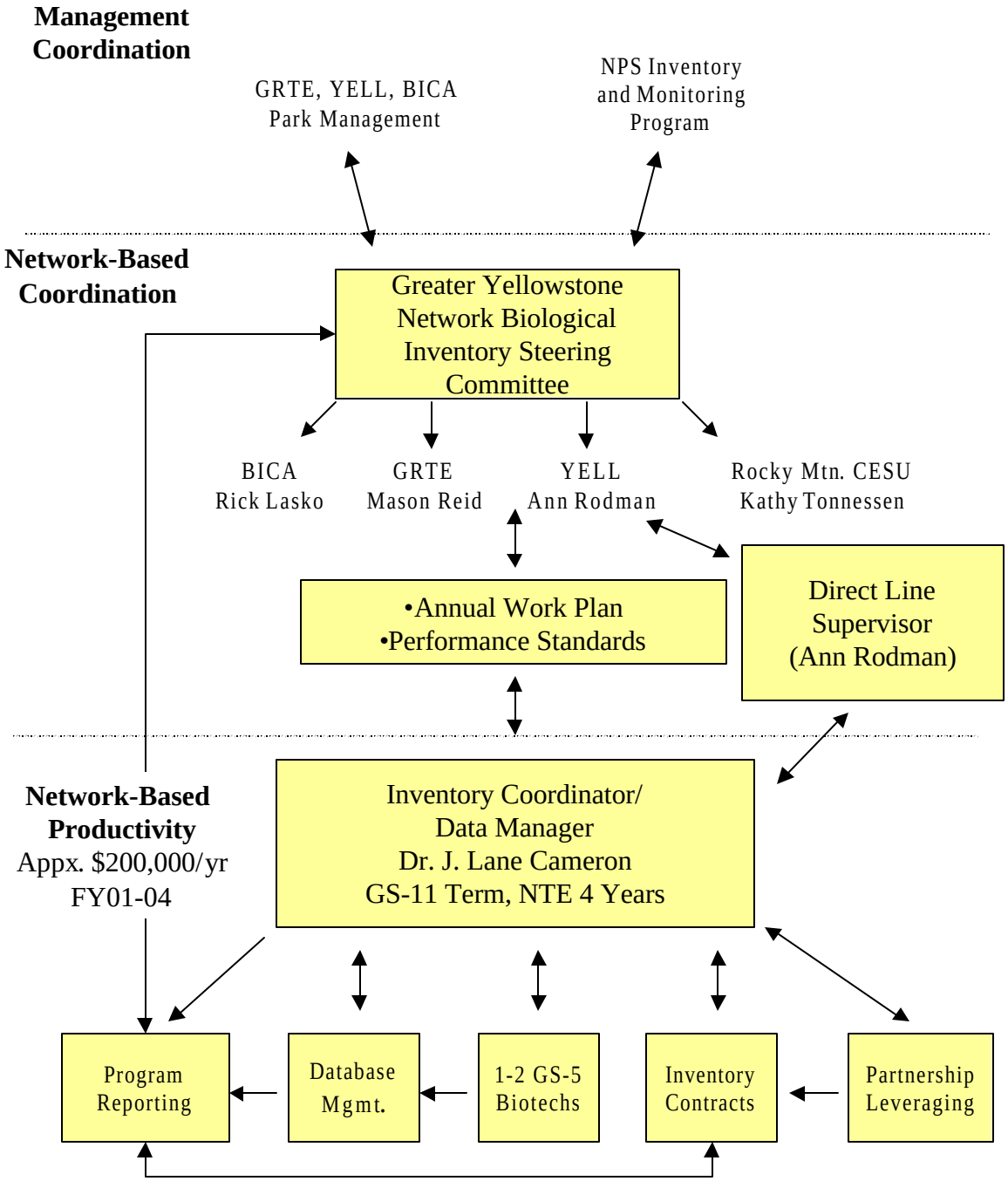

Figure 2

PROGRESS TO DATE

The Greater Yellowstone Network submitted a pre-proposal on December 21, 1999, to describe how the network parks will work together to develop this biological inventory study plan. The network formed a steering committee, consisting of representatives from each park (Martina Keil, BICA; Mason Reid, GRTE; Mary Hektner, YELL; Dr. Glenn Plumb, YELL; Ann Rodman, YELL), with Dr. Kathy Tonnessen of the Rocky Mountains CESU as chair. Over the course of early 2000, the steering committee held regular conference calls to outline the strategy for writing the study plan and to identify experts to assist in the inventory process.

On May 2-3, the network hosted a workshop in Bozeman, Montana, where scientists, university researchers, USGS-BRD personnel, and park experts provided information on proposed inventory study designs, methodologies, and associated costs. Approximately 30 local and regional experts came together during this workshop to advise the network, determine the status of existing information, and identify information gaps that should direct inventory efforts. The workshop was broken into three discussion groups: 1.) Fish and herpetofauna; 2.) Vascular plants; and 3.) Mammals and birds.

In addition, park staff traveled to the network parks to update inventory databases, including NPSpecies, natural resource bibliographies, and the Dataset Catalog. Substantial progress was made on these databases and they are available in electronic format.

The following deliverables were identified in the pre-proposal. All of these have been completed by the network:

- Summary of existing inventories (see the Dataset Catalog)
- Summary of statements from park legislation, master plans, GMPs, RMPs, and interviews with managers and biologists regarding management needs from inventories (see park background statements)
- Summary of stressors and threats to park natural resources as they relate to data needs from the I&M program (see park background statements)
- Initial draft of the Dataset Catalog used in inventory existing data (transmitted electronically)
- Initial draft of the NPSpecies database, including documentation of existing references and voucher specimens (transmitted electronically)
- Summary of existing GIS themes for each park (see page 37)
- Briefing material package handed out prior to May 2000 study plan workshop (completed)
- Summary report of study plan workshop (completed)
- Updated natural resource bibliographies (transmitted electronically)
- Full study plan (completed)

During September 2000, the draft study plan was circulated for critical review to approximately 30 experts, most of whom attended the Bozeman workshop.

II. BUDGET AND SCHEDULE

Total Requested from NPS Inventory Program, FY00-04: $665,742

Project	FY00	FY01	FY02	FY03	FY04	Total
Prepare Pre-Proposal for Biological Inventory	$33,100					$33,100
GYN Program & Data Management		111,000	56,142			167,142
Non-native Vascular Plant Inventory (BICA, GRTE, YELL)		10,000	77,000	77,000	76,000	240,000
BICA Vascular Plant Inventory		10,000				10,000
Alpine Vascular Plants Inventory (YELL)				5,000	5,000	10,000
Rare Vascular Plant Inventory (GRTE)		5,000				5,000
Bat Inventory (BICA, GRTE, YELL)			8,000	20,000	32,000	60,000
Amphibians/Reptiles Inventory (BICA, GRTE, YELL)		29,000	12,500	11,000		52,500
Mammal Inventory (BICA)			19,000	19,000		38,000
Inventory of Yellowstone Cutthroat Trout (GRTE, YELL)					35,000	35,000
Alpine Lake Fish Inventory (GRTE)		4,000	3,000	3,000		10,000
Bald Eagle and Sage Grouse Survey (GRTE)		2,000	1,500	1,500		5,000
TOTAL	**$33,100**	**$171,000**	**$177,142**	**$136,500**	**$148,000**	**$665,742**

Project	FY00	FY01	FY02	FY03	FY04	Total
Funding Need for Program and Data Management (to be transferred from forthcoming monitoring funding - see budget justification below)			$46,758	$95,700	$89,200	**$231,658**

Budget Justification

Provisional NPS-WASO Allocation. The Greater Yellowstone Network was provisionally allocated $665,742 for a three-park biological inventory program (Gary Williams, NPS-WASO pers. comm.). This total was to include the FY00 pre-proposal ($62,000) and a balance to conduct FY01-04 biological inventories ($603,742). The Greater Yellowstone Network parks jointly hosted a vertebrate and vascular plant inventory workshop on May 2-3, 2000, to identify and refine program objectives and cost estimates. The projects and associated costs described above were identified and prioritized through the workshop scoping process and by park managers.

Costs Estimated by GYN. The GYN has prepared a budget that reflects the actual costs for biological inventories as well as a fully functional program management capability. Program management and database management functions will be under the direct leadership of an NPS employee, Dr. J. Lane Cameron (GS-11 biologist-term), located at Yellowstone National Park. Yellowstone National Park is providing office space, utilities, employee supervision, and support/administration at no additional cost. Without taking into account the pre-funding of amphibian/reptile inventories described below, the total GYN FY01-04 budget is $897,400 (76% for salaries, 13% for travel, and approximately 5% each for supplies and other miscellaneous expenses). This is $231,658, mostly for data and program management, over the $665,742 initially allocated to the network.

The Greater Yellowstone Network proposes to finance the difference with funding from the network's monitoring program, scheduled to begin in FY01. Based on demonstrated progress through FY04, the network would receive support each year from the NPS monitoring program in FY02-04 to continue the GYN inventory program in addition to implementing monitoring efforts. Should monitoring funding not be available for transfer, the inventory coordinator would prioritize projects in FY02-04 and work within the constraints of the provisional allocation. Under these circumstances, the three parks could also pursue other alternative funding sources.

Pre-Proposal Cost Savings. During FY00, the three GYN parks in cooperation with the Rocky Mountains Cooperative Ecosystem Studies Unit elected to write the final study plan without the assistance of a contractor. Based upon input from the GYN biological inventory workshop and park managers, CESU and park staff developed the study plan through two writing workshops (GRTE, June 2000 and YELL, August 2000) and continual park-specific writing assignments shared digitally by email and compiled by Yellowstone staff.

Subsequently, the GYN has completed the final study plan under-budget with a residual balance of $28,900. The GYN parks have elected to utilize this residual

FY00 balance to partially pre-fund the budget for the amphibian and reptile inventory that will be conducted by Idaho State University, Dr. Charles Peterson.

Actual Costs. Following upon the enhanced FY00 efficiency demonstrated by the GYN parks in developing the final study plan, the GYN total FY01-04 budget projection is $897,400.

Projected Budget by Line Item

Item	% of Total Budget	FY01	FY02	FY03	FY04	Total
Salary	76.6%	$121,752	$176,300	$180,550	$183,850	$662,452
Travel/Per Diem	12.6%	28,144	28,900	28,450	23,350	108,844
Supplies	5.3%	12,200	7,700	8,200	17,500	45,600
Miscellaneous/ Overhead	5.5%	8,904	11,000	15,000	12,500	47,404
TOTAL		**$171,000**	**$223,900**	**$232,200**	**$237,200**	**$864,300**

Park	% of Total Budget	FY01	FY02	FY03	FY04	Total
BICA	36.1%	$61,731	$80,828	$83,824	$85,629	$312,012
GRTE	33.1%	56,601	74,111	76,858	78,513	286,083
YELL	30.8%	52,668	68,961	71,518	73,058	266,205
TOTAL		**$171,000**	**$223,900**	**$232,200**	**$237,200**	**$864,300**

Note: These tables do not reflect the $33,100 allocated to the GYN for writing the study plan proposal.

III. PARK BACKGROUNDS

BIGHORN CANYON NATIONAL RECREATION AREA

Bighorn Canyon National Recreation Area was created in 1966, following the construction of the Yellowtail Dam on the Bighorn River. The park, located in southeastern Montana and north-central Wyoming, protects 71 miles of Bighorn Lake as it winds through spectacular canyons carved by the Bighorn River. Upland prairies, broad valleys, forests, and mountains also define the landscape.

Bighorn Canyon's purpose, as defined by its enabling legislation, is to:

> *…provide for recreation use and enjoyment of Bighorn Lake and adjacent lands, and to preserve the scenic, scientific, and historic resources.*

Bighorn Canyon National Recreation Area comprises approximately 68,490 acres. The park also includes 8,079 acres of the Pryor Mountain Wild Horse Range. The 1984 Herd Management Area Plan includes a memorandum of understanding between the Park Service and the BLM. The MOU allows for management of the wild horses by the BLM in a manner that is compatible with the purposes for which Bighorn Canyon was established.

Bighorn Canyon manages 11,600 acres of the 19,424-acre Yellowtail Wildlife Habitat Area in cooperation with the Wyoming Game and Fish Department. The area provides habitat for waterfowl, upland game, and various raptor species, including bald eagles. Hunting and fishing are permitted in accordance with state regulations.

Approximately 235,000 people visit Bighorn Canyon annually, most of whom remain within the Bighorn Lake corridor. Motorized boating along the lake accounts for most recreational use during the summer; in the fall, hunting is a popular activity.

Like many other national recreation areas, Bighorn Canyon's enabling legislation provides for hunting, trailing, and grazing within the park. There are four grazing permits, occupying 8,000 acres of the park. Twelve trailing permits were issued for 2000-2001.

The park's 1980 *General Management Plan* states:

> *The preservation of the natural environment for the enjoyment of the recreation area visitors and for the integrity of the ecosystems is the major objec-*

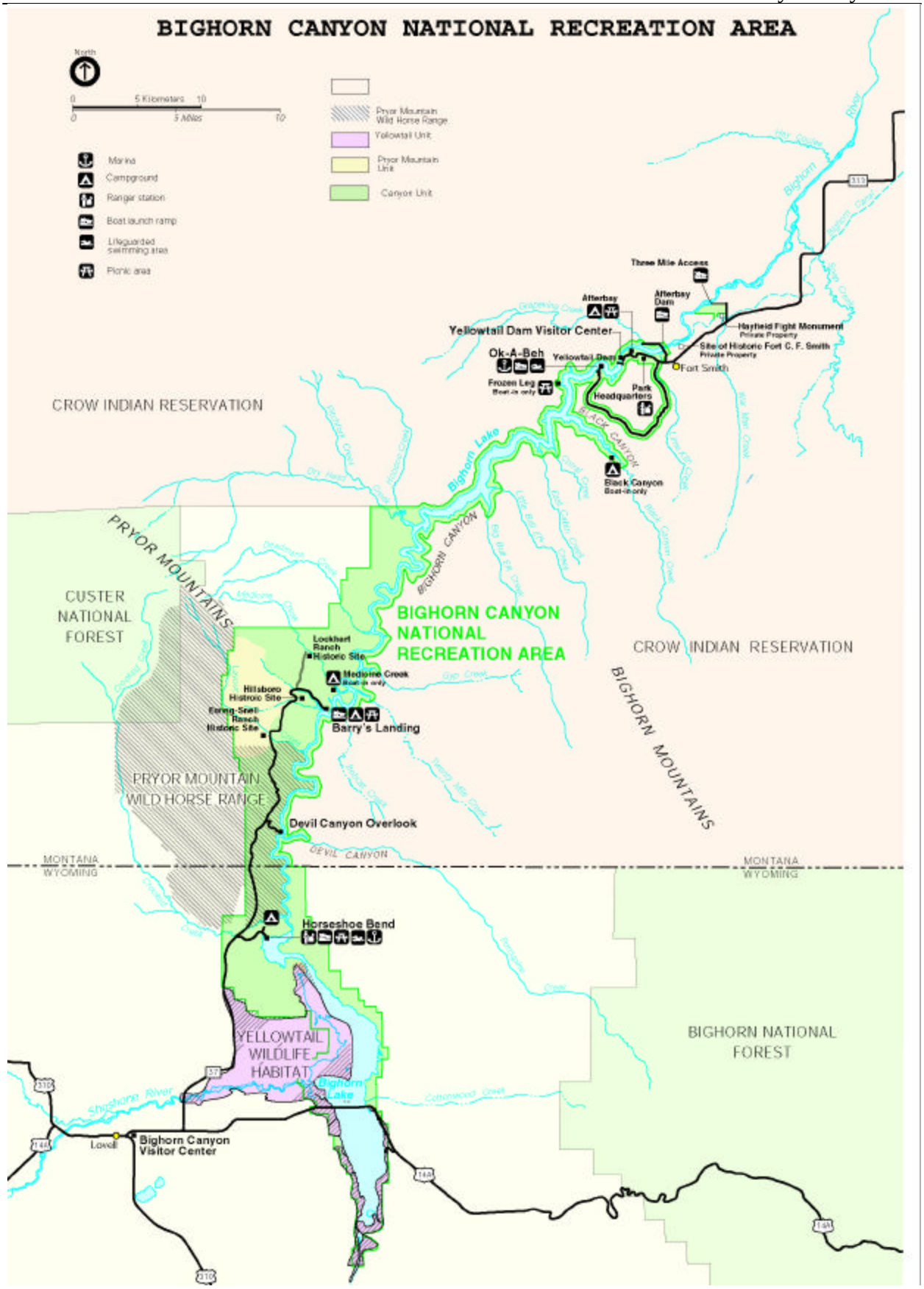
BIGHORN CANYON NATIONAL RECREATION AREA
North
0 5 Kilometers 10
0 5 Miles 10
Marina
Campground
Ranger station
Boat launch ramp
Lifeguarded swimming area
Picnic area
Pryor Mountain Wild Horse Range
Yellowtail Unit
Pryor Mountain Unit
Canyon Unit
Three Mile Access
Afterbay
Afterbay Dam
Yellowtail Dam Visitor Center
Hayfield Fight Monument
Private Property
Site of Historic Fort C. F. Smith
Private Property
Fort Smith
Ok-A-Beh
Yellowtail Dam
Frozen Leg
Boat-in only
Park Headquarters
CROW INDIAN RESERVATION
Bighorn Lake
BLACK CANYON
Black Canyon
Boat-in only
PRYOR MOUNTAINS
BIGHORN CANYON
CUSTER NATIONAL FOREST
BIGHORN CANYON NATIONAL RECREATION AREA
CROW INDIAN RESERVATION
Lockhart Ranch Historic Site
Medicine Creek
Boat-in only
Hillsboro Historic Site
Ewing-Snell Ranch Historic Site
Barry's Landing
BIGHORN MOUNTAINS
PRYOR MOUNTAIN WILD HORSE RANGE
Devil Canyon Overlook
DEVIL CANYON
MONTANA
WYOMING
MONTANA
WYOMING
Horseshoe Bend
YELLOWTAIL WILDLIFE HABITAT
BIGHORN NATIONAL FOREST
Bighorn Lake
Shoshone River
Lovell
Bighorn Canyon Visitor Center
310
37
14A
310

Figure 3

tive of this natural resource management plan.

The goal of the National Park Service management is to restore or maintain the landscape in a pristine condition and to minimize the impact of human activities.

Climate and Physical Characteristics

Weather patterns in the region are affected primarily by the Bighorn and Pryor mountains, which receive a greater proportion of precipitation than the lowlands. Temperature extremes at Fort Smith and Lovell range from over 100 degrees Fahrenheit to –15 degrees Fahrenheit. Extreme cold does not usually last long, however, as warmer Chinook winds bring mild temperatures and melt snow. Precipitation, about one-third of which comes as snow, ranges between seven inches at Lovell and 20 inches at Fort Smith. Elevations within Bighorn Canyon range from 3,600 feet at Bighorn Lake to 4,500 feet on East Pryor Mountain.

Bighorn Canyon Species at a Glance
- 776 plants
- 46 mammals
- 4 amphibians
- 9 reptiles
- 28 fish
- 212 birds
- 1 threatened species

Most of the topographic relief of the region is an expression of uplift of the Rocky Mountains that began about 70 million years ago. This uplift created the numerous anticlines, synclines, and domes in the area. Seas covered much of the area prior to the uplift, creating the layers of marine and sedimentary rock that are common in the park. Hogbacks are common around the northern end of the park near Fort Smith.

There are many geologic landforms associated with erosion processes that followed uplift of the region. Slow-moving mudslides occurred during the moister glacial period, but much of this debris has been eroded away. Floods have deposited alluvium in major tributaries and along the sides of the Bighorn River, and uplift and/or down-cutting of the Bighorn River has eroded these deposits into terraces that are still visible below the Yellowtail Dam.

The Yellowtail Dam, located near the northern edge of the park, dominates Bighorn Canyon's hydrology and aquatic resources. The dam creates the 13,000 acres of Bighorn Lake and is operated by the Bureau of Reclamation. The Bighorn River and the Shoshone River, which flows into Bighorn Lake just beyond the southwestern park boundary, are by far the two largest drainages. Other minor streams, originating in the Pryor and Bighorn mountains, form side canyons along Bighorn Lake. Concentrations of nutrients, sediments, and total dissolved solids are high in park streams, primarily due to runoff from agricultural sources upstream. The EPA and USGS monitor water quality in the park.

Vegetation

Some 776 species of vascular plants have been documented within Bighorn Canyon. The most important factor in determining vegetative community is the availability of water, which is dictated by elevation, aspect, and drainage patterns. The major vegetative communities are desert shrubland, juniper/grass, foothills grassland, canyon wall, riparian woodlands, and pine savanna. Desert shrubland is common in the south, juniper/grass in the middle, and grassland in the north. Over 60 non-native species existing in the park present a significant management challenge.

Vertebrates

Twenty-eight fish species exist in Bighorn Canyon National Recreation Area and represent both cold and warm water species. Fisheries in the park are managed primarily for recreational sport fishing. The Montana Department of Fish, Wildlife, and Parks and the Wyoming Game and Fish Department stock Bighorn Lake with a variety of species. Tributary streams of Bighorn Lake are the primary spawning grounds for most of the park's fish species.

Thirteen species of reptiles and amphibians have been documented in Bighorn Canyon. The desert and riparian habitats permit reptile and amphibian populations to thrive throughout the park. However, the health of the park's reptile and amphibian populations are unknown, and in light of global changes in reptile and amphibian populations, warrants additional study.

The park's sheer walled canyons provide important habitat for raptors, including peregrine falcons and bald eagles, as well as other bird species. In all, 212 bird species have been documented in Bighorn Canyon.

Forty-six species of mammals have been documented in Bighorn Canyon, and another 20 species may be present based on habitat characteristics. Mule deer and bighorn sheep are present throughout the year in the park. Black bear and mountain lions have been observed in the park, although less is known about them.

Threatened and Endangered Species

Bighorn Canyon includes habitat for one species listed under the Endangered Species Act: the bald eagle. This species is present in the park, and there may be some year round populations.

Park Issues

Bighorn National Recreation Area totals approximately 68,490 acres of diverse flora and fauna and provides excellent opportunities for various recreational activities. This combination in an area with such severe climatic variation often results in management scenarios that prove challenging for park resource personnel. Bighorn Lake attracts anglers, water-sport enthusiasts, and sightseers throughout much of the year. The lake elevation is in constant fluctuation and area flooding occurs. Hunting is permitted and portions of the park contain non-native fish and game species managed by the Wyoming Game and Fish Department. The Pryor Mountain Wild Horse Range encompasses 8,000 acres is managed by the Bureau of Land Management. Grazing and trailing continue in the park, and much of the park is abandoned agricultural land.

The natural resource issues facing Bighorn Canyon result in a variety of stresses to the natural ecosystem processes, including:

- The spread of non-native plant species infestations, especially in areas of potential high plant and animal species diversity
- Grazing and trampling in areas where plant and animal species are not well documented
- Resource competition between native and non-native wildlife
- Air and water quality degradation
- Habitat degradation with increased visitor use

GYN Species Listed as Threatened or Endangered under the Endangered Species Act

Species	Status	Parks with Species Presence
Whooping Crane	*Endangered*	*GRTE, YELL*
Gray Wolf	*Endangered/Experimental*	*GRTE, YELL*
Bald Eagle	*Threatened*	*BICA, GRTE, YELL*
Grizzly Bear	*Threatened*	*GRTE, YELL*
Lynx	*Threatened*	*GRTE, YELL*

Figure 4

GRAND TETON NATIONAL PARK

Grand Teton National Park was first established in 1929, and was subsequently expanded in 1943 and 1950. The park comprises 310,521 acres and receives 3.7 million visitors per year. Grand Teton is famous for its high alpine scenery, including meadows, lakes, and glaciers. The park purpose as stated in the park's 1976 Master Plan is:

> *Grand Teton was established as a unit of the National Park System to protect the scenic and geological values of the Teton Range and Jackson Hole, and to perpetuate the Park's indigenous plant and animal life. The Park will interpret these natural and scenic values, in association with the historical significance of the region, in a manner that preserves these resources for the benefit and pleasure of present and future generations.*

Grand Teton National Park also administers the 23,777-acre John D. Rockefeller, Jr. Memorial Parkway, which connects Grand Teton with Yellowstone. The 1972 act establishing the parkway called for the area to be administered in accordance with the National Park Service Organic Act of 1916. The parkway is thereby committed to conserving the scenery and the natural and historical resources and providing for their use in a manner that will leave them unimpaired for future generations.

Some of the parks' management objectives, as stated in the 1989 Statement for Management, include:

- Manage all park natural resources under ecosystem concepts that are aimed at perpetuating natural systems rather than individual species or features. Establish ecologically sound limits and manage all activities and uses to ensure compatibility with the preservation of park resources and a positive visitor experience.
- Manage wildlife under conditions that are natural and unrestrained.
- Cooperatively manage the Snake River drainage to ensure perpetuation of the native cutthroat trout as a wild population.

Grand Teton is unusual among most NPS areas classified as a national park, because of several non-conforming uses that occur within park boundaries and existed prior to the expansion of the park in 1950. The Jackson Hole airport, located within park boundaries, serves several commercial airlines and is the busiest airport in northwest Wyoming. Six permittees graze domestic livestock on 24,792 acres of the park—a use that was allowed as part of the park's enabling and subsequent legislation. Grand Teton also allows an annual elk hunt in designated portions of the park as part of an interagency elk management program included in its enabling legislation. Hunting is permitted within John D. Rockefeller, Jr.

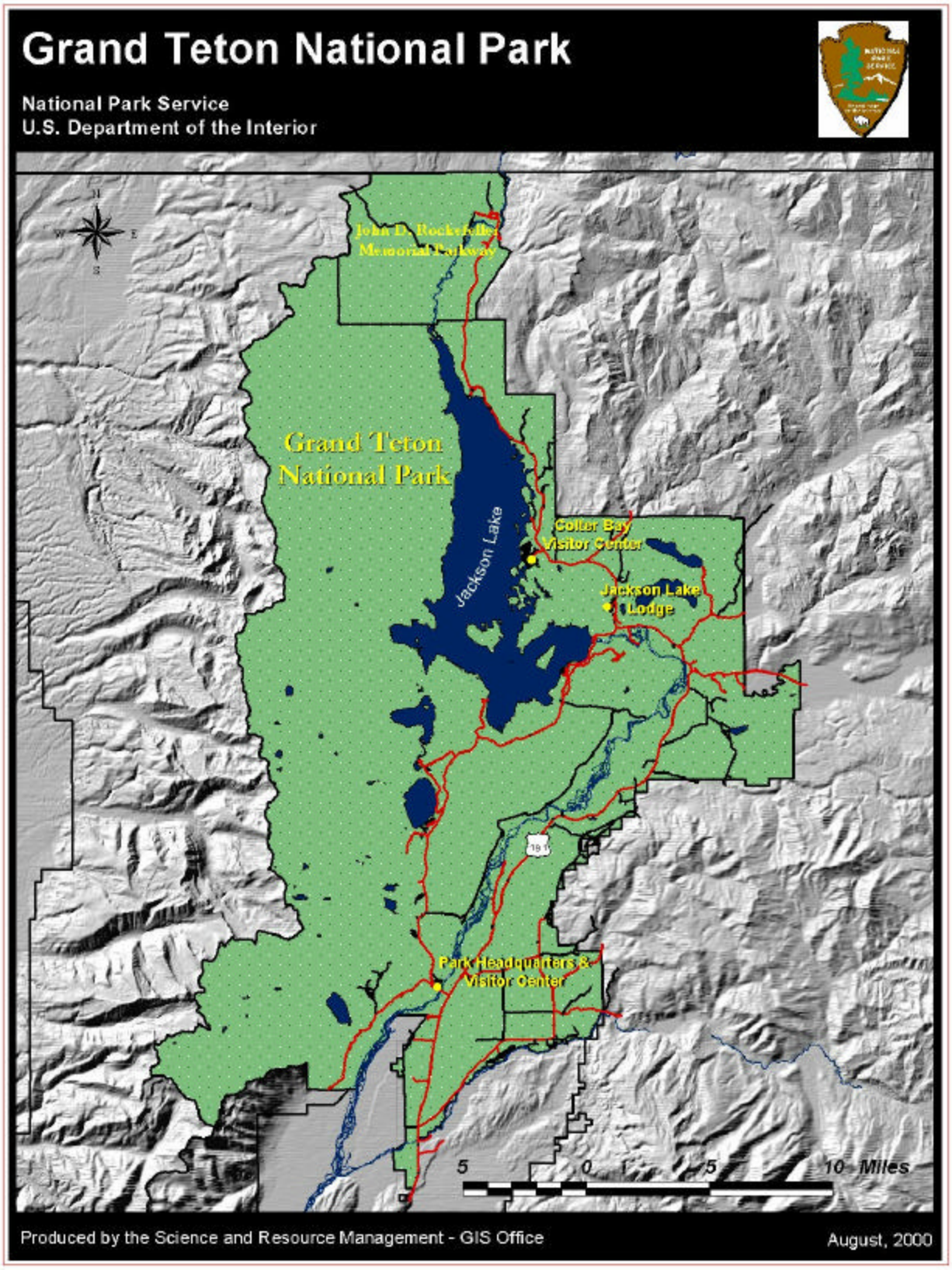
Grand Teton National Park
National Park Service
U.S. Department of the Interior
John D. Rockefeller Memorial Parkway
Grand Teton National Park
Jackson Lake
Colter Bay Visitor Center
Jackson Lake Lodge
191
Park Headquarters & Visitor Center
5 0 5 10 Miles
Produced by the Science and Resource Management - GIS Office
August, 2000

Figure 5

Memorial Parkway in accordance with federal and Wyoming laws. Grand Teton also contains the Jackson Lake Reservoir, operated by the Bureau of Reclamation. The Bureau of Reclamation retains complete and exclusive control of the flow and utilization of water in the reservoir, including the right to raise and lower the water level at will. Wyoming Game and Fish Department has purchased sufficient water to maintain a minimum of 280 cubic feet per second flow for the Snake River for fisheries maintenance.

Grand Teton National Park encompasses 115,807 acres of recommended wilderness, mostly along the spine of the Teton Range, with an additional 20,850 acres of potential wilderness.

Climate and Physical Characteristics

Elevations at Grand Teton vary from 6,400 feet to nearly 14,000 feet, resulting in a variety of habitat types. Mean annual precipitation at low elevations in the park (6,244 to 6,800 ft.) increases from south to north, being about 15, 21, 23, and 31 inches at Jackson, Moose, Moran, and the northern boundary of the Rockefeller Parkway, respectively. Much of this precipitation occurs as snow. Diurnal temperature range can be great and subfreezing temperatures are common even during summer. Daytime temperatures can be mild (above 40 degrees Fahrenheit) for brief periods during winter; July maximum temperatures average 78 degrees. Final spring frosts are common in June and autumn frosts first occur in early September, resulting in a very short growing season.

About eight million years ago, the ancestral Teton Range was fractured along the north-south Teton Fault. The area west of the fault rose to form the present Teton Range and tilted to the west. The area east of the fault dropped below the present Jackson Hole and also tilted to the west. The faulting and tilting of the blocks resulted in a very steep escarpment along the east face of the Teton Range and a gentler slope on the west side.

Extensive, repetitive glacial activity, beginning about 250,000 years ago and lasting until about 9,000 years ago, has been responsible for the present rugged form of the Teton Range and the canyons that penetrate it. Glacial debris from the surrounding mountains accumulated in the valley floor. More than a dozen small glaciers and perennial ice fields still occupy deep, protected recesses in the Teton Range.

Both Grand Teton and Yellowstone are Class I airsheds, where "... prevention of any future, and the remedying of any existing impairment of visibility, ... from manmade air pollution" is a national goal.

The core of the Teton Range is metamorphic gneisses and schists and igneous rocks (granite and pegmatite). Intermittent vol-

canic activity during much of the last 50 million years caused interlayering of volcanic and sedimentary rocks. Volcanic rock that originated from massive eruptions in Yellowstone National Park covered the very north end of the Teton Range and the northeastern end of Jackson Hole as recently as 1.5 million years ago.

Approximately ten percent of Grand Teton is covered by surface water. About 100 alpine lakes (varying from one to sixty acres) are within the Teton Range, mostly above 9,000 feet elevation. All surface and ground water in the park drains into the Snake River, which originates in highlands of the Teton Wilderness Area (USFS), flows north and west through part of Yellowstone National Park, south through the John D. Rockefeller, Jr. Memorial Parkway and into Jackson Lake in Grand Teton. From Jackson Lake, the Snake River flows east and then south for about 25 miles before crossing Grand Teton's south boundary. Management of fisheries in the Snake River is a cooperative effort among the National Park Service, the U.S. Forest Service, and the Wyoming Game and Fish Department.

Vegetation

More than 1,000 species of vascular plants (Shaw 1992) and over 200 species of fungi (McKnight 1980) occur in Grand Teton National Park or nearby Teton County, Wyoming. Over 120 non-native plant species have been documented. The U.S. Fish and Wildlife Service lists one threatened species, Ute Ladies-tresses (*Spiranthes diluvialis*), as possibly occurring in Grand Teton, but it has never been identified there.

The valley floor of Grand Teton is primarily covered by sagebrush/grass plains occasionally interrupted by glacial moraines and buttes. The dominant feature of the valley floor is the Snake River and its floodplain, which is forested by cottonwoods, spruce, willows, and aspens. The understory consists of various grasses, sedges, forbs, and shrubs characteristic of western montaine riparian ecosystems. The vegetation changes with increased elevation to that typical of the central Rocky Mountain region. The mountain forests consist mainly of lodgepole pine and scattered stands of Douglas-fir and aspens at lower elevations; Engelmann spruce, whitebark pine, and subalpine fir at higher elevations.

Vertebrates

Nineteen species of fish have been documented in Grand Teton. The cutthroat trout, the only trout native to the park, is part of a morphologically distinct group (possibly a race) of cutthroat trout found only in the Snake River in the Jackson Hole area. Four introduced trout species presently inhabit portions of the upper Snake River drainage in the park—lake trout, brown trout, brook trout, and rainbow trout. A relict population of leatherside chub exists near the mouth of the Buffalo Fork River—the only known population of this species in the Snake River

drainage. A single specimen of the June sucker was collected from the Snake River below Jackson Lake in 1927, but is now probably extinct.

Four reptiles and six amphibians have been documented in Grand Teton and John D. Rockefeller, Jr., mostly occurring along the valley floor and foothill regions of the parks (Koch and Peterson 1995). The leopard frog and sagebrush lizard were rediscovered only in the last seven or eight years.

Grand Teton Species at a Glance

- 1056 species of vascular plants; over 120 of which are non-native
- 61 mammals
- 6 amphibians
- 4 reptiles
- 19 fish
- 299 birds
- 5 threatened or endangered species

Almost 300 species of birds have been observed in the park. Some of the more prominent species are the white pelican, great blue heron, trumpeter swan, Canada goose, sandhill crane, golden eagle, bald eagle, sage grouse, common raven, Clark's nutcracker, several species of woodpeckers, and a variety of songbirds.

Sixty-one species of mammals have been documented in Grand Teton. With the recent return of gray wolves to Grand Teton, all mammals present before European settlement currently occur in the park. Mountain goats and raccoons, both non-native species, occur in low numbers. Some of the more common mammals are elk, moose, bison, black bears, coyotes, pikas, marmots, Uinta ground squirrels, mule deer, and pronghorn. Other mammals that are less commonly seen include the grizzly bear, gray wolf, wolverine, river otter, mountain lion, and beaver.

Threatened and Endangered Species

Grand Teton National Park contains five species listed as threatened or endangered under the Endangered Species Act. The whooping crane is listed as endangered. The bald eagle, lynx, and grizzly bear are listed as threatened, and the gray wolf is listed as endangered/experimental. The gray wolf became established in the park in 1999, approximately seventy years after its extirpation, and the grizzly bear is expanding its range throughout the park. The whooping crane is only a seasonal migrant and does not breed in the park.

Park Issues

Grand Teton receives approximately 3.7 million visitors annually, representing a challenge for both protecting the resource and providing adequate visitor facilities. In addition, the Jackson Hole Airport is contained within the park, and is the only

commercial airport within a national park. The grazing and trailing of domestic livestock is permitted within the park based on the enabling legislation. Several lakes within the park are stocked with non-native fish as part of a sport fisheries program managed by Wyoming Game and Fish Department. As directed by the legislation expanding Grand Teton in 1950, Grand Teton administers an elk reduction ("hunt") within park boundaries in order to cooperatively manage the Jackson elk herd, one of the two largest elk herds in the world, numbering 14,000-18,000 animals. In addition, the herd is infected with brucellosis, a disease that induces abortion in both wild and domestic ungulates. The native Jackson bison herd, numbering approximately 600 animals, is infected with brucellosis, and domestic livestock interests complicate management of the herd.

The heavy visitation and complex resource management issues result in a variety of stresses to the natural resources, including:

- Degradation of natural quiet and visitor experiences
- Impacts to air and water quality (and their associated impacts to native species)
- Competition for resources between domestic livestock and native species
- Increase in the spread of non-native plants
- Impacts associated with park infrastructure supporting high visitation

YELLOWSTONE NATIONAL PARK

Yellowstone National Park was created as the world's first national park in 1872 to be a:

> *"public park or pleasureing-ground for the benefit and enjoyment of the people."* and to *"...provide for the preservation, from injury or spoilation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition."*

Yellowstone's purpose, as articulated in the 1974 *Master Plan*, is:

> *To perpetuate the natural ecosystems within the park in as near pristine conditions as possible for their inspirational, educational, cultural, and scientific values for this and future generations.*

Today, Yellowstone National Park encompasses over 2.2 million acres and receives approximately 3.2 million visitors each year. Yellowstone is a sanctuary for one of the largest concentrations of large wildlife found in the lower-48 states. All of the species found before European settlement of the continent still reside within Yellowstone. The park provides visitors with an unmatched place to see wildlife in

its natural habitat, from watching wolves in Lamar Valley, to viewing the annual elk rut every fall.

Some of Yellowstone's park management objectives, as stated in the park's 1998 *Resource Management Plan*, include:

- Base all public and administrative use and development decisions on sound resource management practices and the best available data.
- Establish and maintain an effective program of protection, preservation, management, interpretation, and public use of the park's natural and cultural resources that is based on data obtained through appropriate inventory, monitoring, and research.
- Cooperate with the Greater Yellowstone Coordinating Committee and others in the greater Yellowstone area for the purposes of improving management of cross-boundary ecosystem resources.
- Develop effective programs that restore areas of disturbance, reestablish extirpated species, and mitigate any environmental effects of necessary development projects.

Climate and Physical Characteristics

Elevations within Yellowstone range from 5,200 feet in the north section of the park to over 11,000 feet along the eastern boundary, although much of the park lies between 7,000 and 9,000 feet. Annual precipitation varies from 10 inches near the North Entrance to 80 inches in the Bechler area, resulting in a diverse complement of native species. Temperatures in summer are often characterized by warm days with short afternoon thunderstorms. Winter brings temperatures well below freezing, with heavy accumulations of snow.

Yellowstone is typified by forested volcanic plateaus, surrounded by the Absaroka Mountains on the east, the Gallatins to the northwest, and the Red Mountains on the south. Yellowstone Lake is the most prominent lake in the park with a surface area of 136 square miles. The park's watersheds primarily drain into the Yellowstone and Madison rivers east of the Continental Divide, and the Snake River west of the divide.

Yellowstone is world renowned for its geothermal resources. Here, one can find some 300 geysers—nearly two-thirds of those anywhere on Earth—and more than 10,000 hot springs, fumaroles, and mud pots. The geology of this area is closely tied to its volcanic origins, when cataclysmic eruptions produced the Yellowstone caldera. Magma, located in some places only one to three miles below the Earth's surface here, continues to fuel the hotspot, in turn powering the geysers, hot springs, and other thermal features.

Yellowstone National Park

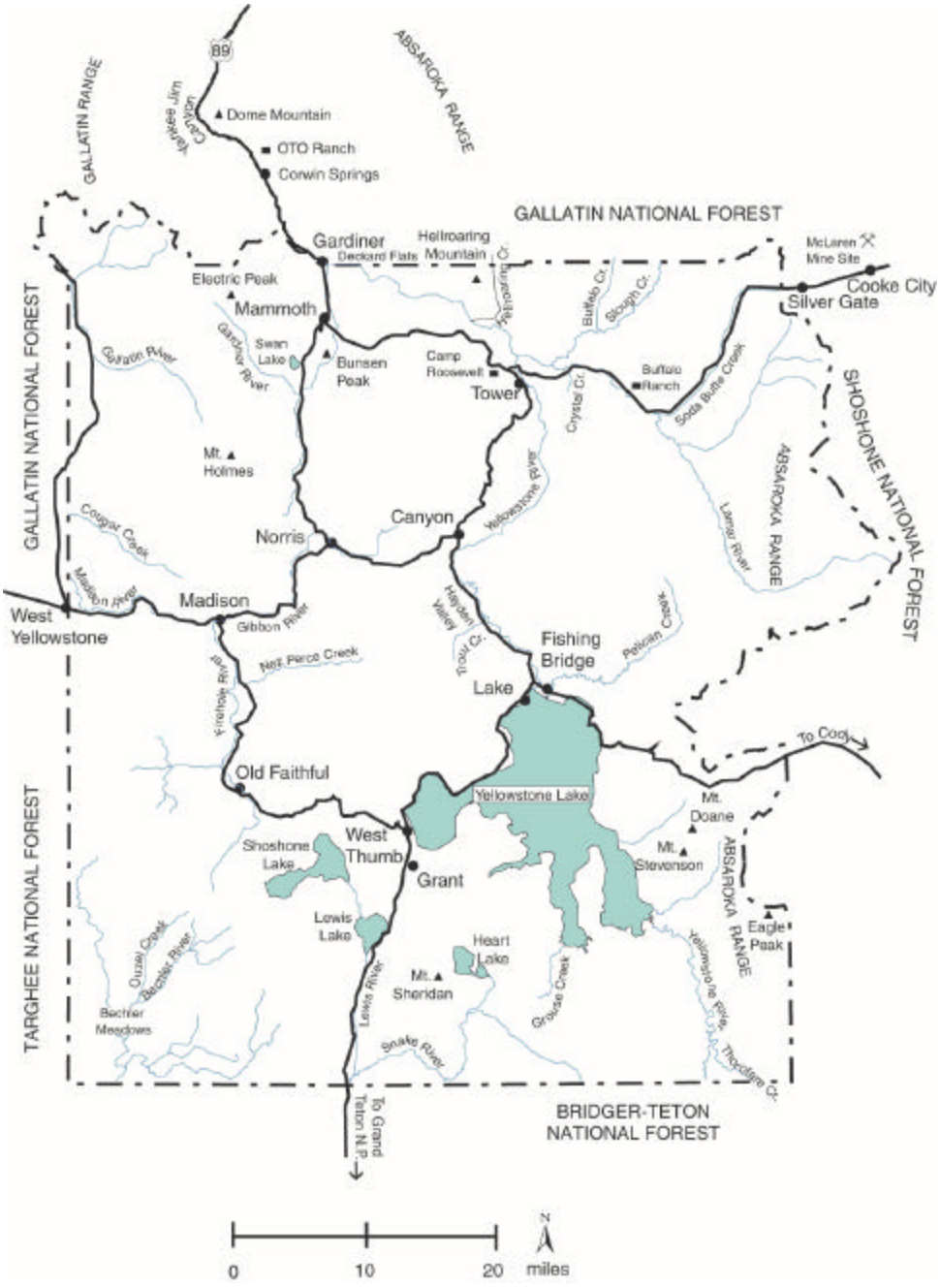

Figure 6

Vegetation

Yellowstone consists of five distinct vegetation zones influenced most heavily by the interaction between geology and climate (Despain 1990, Olliff et al 2000). Four of the five zones are at elevations between 6,500 and 11,000 feet, are underlain by bedrock of volcanic andesite or rhyolite origin, and receive from 20 to 70 inches of precipitation annually. These areas generally support forests dominated by lodgepole pine, Engelmann spruce, subalpine fir, or whitebark pine interspersed with subalpine meadows or alpine tundra above timberline. The remaining zone, primarily along the Yellowstone and Lamar river valleys in the northern portion of the park, encompasses approximately 9% of the total park area. This low-elevation zone (5,200 to 6,500 ft) is underlain by glacial debris of volcanic andesite and sedimentary composition, and receives less precipitation (11 to 20 inches annually). As a result, the areas are dominated by sagebrush steppe and grasslands, and are bordered by Douglas-fir. This cold semi-desert environment provides habitat conditions most susceptible to exotic plant invasion and establishment relative to other vegetation zones in the park. These lower elevations provide critical winter range for elk, bison, and other ungulates.

1,259 vascular plants are found in Yellowstone, including two endemic species (Whipple 2000a). Approximately 100 plant species are listed as species of special concern by the surrounding states' natural heritage or natural diversity database programs.

The number of documented non-native plants in Yellowstone has increased from 85 known in 1986 to more than 180 today. Non-natives represent about 15 percent of the vascular plants in the park (Olliff et al. 2000, Whipple 2000b). Thirty-one of these plants are listed as noxious in one of the three states in which Yellowstone is located (Whipple 2000c).

Vertebrates

Yellowstone provides habitat for 71 species of mammals, many of which are easily viewed from roadside points. Ungulate species include elk, bison, mule deer, pronghorn, and moose. Predators include grizzly bears, mountain lions, gray wolves, and coyotes. Efforts are underway to study the lynx, recently listed as threatened under the Endangered Species Act.

In addition to its terrestrial wildlife, Yellowstone also hosts a diversity of aquatic life within its pristine waters. Yellowstone supports 18 species of fish, including the largest natural cutthroat trout population in the world. These trout provide critical food for as many as 30 different species, including grizzly bears, bald eagles, ospreys, and pelicans. The illicit introduction of non-native lake trout jeop-

ardizes the long-term health of cutthroat populations. Fisheries biologists estimate that lake trout may consume as many as 500,000 cutthroats per year, making active management essential.

Nine reptiles and eight amphibians are documented or expected to occur within Yellowstone National Park. Amphibian population declines throughout the nation, coupled with the likelihood that additional, previously undocumented species inhabit Yellowstone, warrant additional research.

Since Yellowstone's establishment, 315 species of birds have been documented, 148 of which nest in the park. Many of Yellowstone's birds migrate to Mexico and Central and South America for the winter. The park is part of cooperative efforts with other nations to prevent habitat loss, pesticides, and human development from threatening these critical winter ranges. Residing year-round in Yellowstone are common ravens, Canada geese, blue grouse, gray jays, red-breasted nuthatch, American dippers, and others.

Threatened and Endangered Species

Five species occurring within Yellowstone are listed under the Endangered Species Act. Listed as endangered is the whooping crane. Listed as threatened are the grizzly bear, lynx, and bald eagle. The grey wolf is listed as experimental/non-essential and is managed as a threatened species.

Research

Yellowstone hosts a sizeable research program, most of which is conducted by academic institutions and private corporations, foundations, or individuals. In 1999, 256 research permits were granted, making Yellowstone one of the most active units of the National Park System for research. Nonetheless, of the $5.6 million spent in 1998 by public and private sector entities on research in Yellowstone, less than ten percent was provided by the NPS. In addition, much of Yellowstone's research and management programs have focused on threatened and endangered wildlife, or species of high public interest. Little is known about less visible species, such as bats and other small mammals. The *1997-1998 Investigators' Annual Reports*, representing a summary of Yellowstone research, is available on the park web site at: *www.nps.gov/yell/publications/pdfs/iar9798/index.htm*.

Park Issues

Many biologists consider exotic plant establishment to be the largest threat to the integrity of Yellowstone's native plant communities. Non-native plants have been demonstrated to negatively impact ecosystem structure and function by altering soil properties and related processes, plant community dynamics, foraging activity,

and abundance of native ungulates and small mammals (Allen and Hansen 1999, Olliff et al 2000). The geothermal habitats unique to Yellowstone have been altered by exotic plants, potentially compromising the long-term persistence of populations of Ross's bentgrass, an endemic plant found only in a few geothermal environments within the park.

The number of documented exotic plant species in Yellowstone has increased from 85 known in 1986 to over 180 today. Only 22 percent of these species are considered to be "under-control." Thirty-one species (2.4 percent of the flora) are listed as noxious in one or more of the three states in which Yellowstone is located (Whipple 2000b).

The park has an aggressive program of prevention, education, early detection and eradication, control, and monitoring along roadsides and in developed areas. Little, however, is known about the status or impacts of non-native plants in the majority of the park that is undeveloped backcountry.

Wolf management in Yellowstone National Park is complex due to the wide-ranging territorial movements of individual wolves and wolf packs as well as complex ecological mechanisms that underpin predator:predator and predator:prey interactions and ecology. Due to the seasonally mobile habits of wolves and their prey, wolf management extends beyond the park to adjacent private and federal lands.

Since predatory non-native lake trout were discovered in Yellowstone Lake in 1994, Yellowstone National Park fishery biologists have pursued a vigorous adaptive management strategy to halt their expansion. While there is little probability of total lake trout eradication, experts believe population control is feasible especially if spawning-age fish are pursued and removed with vigor. Without an extensive reduction in lake trout abundance, the native Yellowstone cutthroat trout will almost assuredly become a listed threatened and endangered species, and numerous aquatic and terrestrial predators that eat Yellowstone cutthroat trout will be adversely affected.

Due to the high density of grizzly bears and black bears in the park and the high numbers of people visiting the park, an active bear management program is essential to ensure human safety and maintain viable populations of bears. Bear management in Yellowstone is divided into two main components: 1.) Reduction of bear-human conflict; and 2.) Bear research and monitoring.
Several native ungulate species exist

Yellowstone Species at a Glance:

- 1,259 vascular plants, including 2 endemic vascular plant species
- 71 mammals
- 18 fish
- 315 birds
- 8 amphibians
- 9 reptiles
- 5 threatened or endangered species

in Yellowstone National Park at relatively low population densities. Bighorn sheep, moose, and mule deer populations are currently at or near historic lows in the northern portion of the park. Mountain goats are not believed to be native to the park but have been observed with increasing frequency and at increasing numbers along the northern boundary of the park.

IV. GOALS, OBJECTIVES, AND DELIVERABLES

GREATER YELLOWSTONE NETWORK INVENTORY GOALS:

- To document, through existing, verifiable data and targeted field investigations, the occurrence of at least 90 percent of the species of vertebrates and vascular plants currently expected to occur in Bighorn Canyon National Recreation Area, Grand Teton National Park, and Yellowstone National Park.

- To describe the distribution and relative abundance of species of special concern, such as threatened and endangered species, non-native species, and other species of special management interest occurring within park boundaries.

- To provide the baseline information needed to develop a general monitoring strategy and design that can be implemented by parks once inventories have been completed, tailored to specific park threats and resource issues.

- To make information easily available to park managers, resource managers, scientists, and the public.

These goals are grounded in a variety of NPS policies and laws, which provide a framework for the need for baseline information and comprehensive inventories of natural resources. Following is a summary of the major policies and laws that apply to natural resource management and inventories in national parks.

The National Park Service Mission

> *The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. (NPS 2000 Strategic Plan)*

This mission underpins every aspect of the NPS' operation and is fundamental to our national parks' existence. The opportunity for people to enjoy parks into the future exclusively depends upon maintaining park resources in an unimpaired condition. Thus, initiatives like the Greater Yellowstone Network's Inventory Program are crucial to protecting park resources for future generations.

Draft 2000 Management Policies

> *The Park Service will define, assemble, and synthesize baseline inventory data describing the natural resources under its stewardship and will monitor key aspects of those resources, including interrelationships with visitor carrying capacities, at regular intervals to detect or predict changes in their condition. (NPS 2000 Draft Management Policies)*

National Parks Omnibus Management Act of 1998

> *The Secretary shall undertake a program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends on the condition of National Park System resources. The monitoring program shall be developed in cooperation with other Federal monitoring and information collection efforts to ensure a cost-effective approach. (PL 105-391)*

The 2000 Strategic Plan

The National Park Service's 2000 Strategic Plan outlines key mission-oriented goals and outcomes the National Park Service expects to achieve. The Strategic Plan articulates four broad mission goals:

Goal Category I: Preserve Park Resources

Goal Category II: Provide for the Public Enjoyment and Visitor Experience of Parks

Goal Category III: Strengthen and Preserve Natural and Cultural Resources and Enhance Recreational Opportunities Managed by Partners

Goal Category IV: Ensure Organizational Effectiveness

The Inventory and Monitoring Program is most closely related to Goal Category I, Preserve Park Resources. This goal is broken down into two sub-components:

Mission Goal Ia: Natural and cultural resources and associated values are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context.

Mission Goal Ib: The National Park Service contributes to knowledge about natural and cultural resources and their associated values; management decisions about resources and visitors are based on adequate scholarly and scientific information.

Within this goal are other outcomes directly related to the inventory program that the NPS will achieve by September 2005:

- Natural Resource Inventories: Acquire or develop 87 percent (2,203 of 2,527) of the outstanding data sets identified in 1999 of basic natural resource inventories for all parks.
- Vital Signs: 80% of 265 parks with significant natural resources have identified their vital signs for natural resource monitoring.
- Aquatic Resources: The National Park Service has completed an assessment of aquatic resource conditions in parks.

Natural Resource Challenge

The Natural Resource Challenge is a five-year, $100 million action plan to revitalize natural resource management in the national parks. This inventory program is a component of the Natural Resource Challenge.

The Natural Resource Challenge identifies several goals, based on the NPS Strategic Plan:

- National parks are preserved so that this generation and future generations can enjoy, benefit, and learn from them.
- Management of the national parks is improved through a greater reliance on scientific knowledge.
- Techniques are developed and employed that protect the inherent qualities of national parks and restore natural systems that have been degraded; collaboration with the public and private sectors minimizes degrading influences.
- Knowledge gained in national parks through scientific research is promulgated broadly by the National Park Service and others for the benefit of society.

OBJECTIVES

Bighorn Canyon National Recreation Area

Vascular Plants

1. Conduct an inventory of native vascular plant species in Bighorn Canyon in FY01. Recent work in Bighorn Canyon has revealed 70 previously undocumented vascular plant species. In order to fulfill the servicewide goal of 90 percent completeness, a more thorough presence/absence inventory of vascular plant species is necessary.

2. Complete an inventory of non-native plants, with particular emphasis on outlying (backcountry) areas. Non-native plant surveys will take place over a three-year period (FY02 - FY04), with the development of sampling procedures, selection of teams, and the preparation of logistics occurring in FY01.

Vertebrates

1. Conduct a presence/absence inventory for mammals within Bighorn Canyon. A review of the current mammal inventory list revealed poor or missing documentation for many species. A more thorough inventory, with sound documentation, adds to the knowledge base available to managers when planning and implementing projects in and around Bighorn Canyon.

2. Conduct a presence/absence inventory for bats within Bighorn Canyon. A three-year program of targeted species surveys and systematic surveys will allow managers to complete inventories to the 90 percent level.

3. Determine the species composition of amphibians and reptiles in Bighorn Canyon. Recent declines in amphibians on a worldwide scale have created concern of localized extinctions. Surveys would take place over three years.

Grand Teton National Park

Vascular Plants

1. Complete an inventory and distribution and abundance study of non-native plants, with particular emphasis on outlying (backcountry) areas. Non-native plant surveys will take place over a three year period (FY02 - FY04), with the development of sampling procedures, selection of teams, and the preparation of logistics occurring in FY01.

2. Determine the distribution and abundance of a newly discovered and potentially rare plant (*Stephanomeria fluminea*) endemic to eastern Grand Teton. Surveys will take place in targeted habitats during one field season.

Vertebrates

1. Determine the species composition of bats in Grand Teton. Very little information is available and surveys have not been performed in almost 20 years, when limited habitat was sampled. Two seasons of surveys should determine the presence/absence of the species expected to occur.

2. Determine the species composition of amphibians and reptiles in Grand Teton. Recent declines in amphibians on a worldwide scale have created concern of

localized extinctions. Surveys would take place over three years.

3. Determine the distribution and abundance of the Yellowstone and Snake River cutthroat trout in Grand Teton. Additional information will help determine the status of the subspecies for potential listing under the Endangered Species Act. Surveys will be conducted during one season.

4. Determine the species composition of fish in alpine lakes in Grand Teton. Adequate surveys have not been performed for over 60 years. Surveys will be conducted over three seasons.

5. Locate and document all bald eagle nests and sage grouse leks using aerial surveys. Surveys will be performed for three consecutive years.

Yellowstone National Park

Vascular Plants

1. Complete an inventory and distribution and abundance study of non-native plants, with particular emphasis on outlying (backcountry) areas. Non-native plant surveys will take place over a three year period (FY02 - FY04), with the development of sampling procedures, selection of teams, and the preparation of logistics occurring in FY01.

2. Systematically survey vascular plants in the alpine zone of the Gallatin Range of Yellowstone National Park. Most botanical efforts in Yellowstone have been directed at areas relatively close to established roads, and have largely neglected alpine flora in the remote, less visited portions of the park.

Vertebrates

1. Conduct presence/absence surveys for bats within Yellowstone National Park. Little information is available on bats within the park; the most recent study documented only three species in the Greater Yellowstone Area and predicted that as many as six other species may be present.

2. Conduct targeted species surveys, repeat historic surveys, and conduct systematic surveys for reptiles and amphibians to determine presence/absence and limited distribution and abundance information. The most recent survey for reptile and amphibian presence/absence in Yellowstone occurred before 1991. The worldwide population declines for amphibians and reptiles in recent years necessitate more current and additional baseline information about these species.

3. Sample cutthroat trout within the Snake River drainage and upper Yellowstone River of Yellowstone National Park to determine the status of Snake River and Yellowstone cutthroat trout. Other fish species will be sampled to determine the assemblage of fish in this drainage. The inventory will utilize both targeted species surveys and historic surveys.

DELIVERABLES

The Greater Yellowstone Network recognizes that communication of data with park managers, other scientists, and the public is an essential component of the inventory process. Each study will produce a variety of products that will be delivered to the network parks, the I&M coordinator, and the servicewide I&M program manager. Furthermore, products will be available to other researchers and the public as appropriate. In addition, all databases and GIS themes will be compatible with servicewide data management applications.

The inventory coordinator will produce an annual report, and at a minimum, each inventory will produce the following:

- An annual progress report, detailing the major accomplishments for the year and the remaining work to be done
- A final report
- Microsoft Access databases (or other accepted databases where appropriate) of all information collected
- Relevant ArcView GIS themes
- Metadata, in accordance with FGDC[1] standards
- Updated versions of NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog

A more specific list of deliverables is included with each project description.

[1]Federal Geographic Data Committee

V. Current Information and Knowledge

Species Presence/Absence in Greater Yellowstone Network Parks.

Park/Taxa	*Number of Species Documented*	*Percent of Expected Species Presence/Absence Documented*
Vascular Plants		
Bighorn Canyon	*776*	*~75%*
Grand Teton	*1,056*	*≥90%*
Yellowstone	*1,259*	*≥90%*
Mammals		
Bighorn Canyon	*46*	*~ 70%*
Grand Teton	*61*	*≥90%*
Yellowstone	*71*	*≥90%*
Amphibians		
Bighorn Canyon	*4*	*~65%*
Grand Teton	*6*	*≥90%*
Yellowstone	*8*	*≥90%*
Reptiles		
Bighorn Canyon	*9*	*~70%*
Grand Teton	*4*	*~80%*
Yellowstone	*9*	*~75%*
Fish		
Bighorn Canyon	*28*	*≥90%*
Grand Teton	*19*	*≥90%*
Yellowstone	*18*	*≥90%*
Birds		
Bighorn Canyon	*212*	*≥90%*
Grand Teton	*299*	*≥90%*
Yellowstone	*315*	*≥90%*

Figure 7

Bighorn Canyon National Recreation Area

Vascular Plants

An unpublished list of all plant species at Bighorn Canyon National Recreation Area includes 776 species. Current documentation for these

species is varied and the existence of voucher specimens for each listed species is currently being verified. During rare plant work in 1998 and 1999, botanists discovered 70 additional vascular plant species previously undocumented in Bighorn Canyon. Consultation with botanists familiar with the park's habitats has resulted in an estimated presence/absence completion for vascular plant species of 75 percent.

Mammals

There are three publications that specifically address the presence/absence of mammals in Bighorn Canyon. A bird and mammal inventory published in 1985 lists 67 mammal species (Patterson 1985). Forty-six of these species have some form of documentation, ranging from capture/collection to wildlife observation cards. The remaining 21 species are included based on habitat preference and the presence of such habitat in Bighorn Canyon. Bat species listed in Worthington and Ross (1990) include a species not listed in either Patterson (1985) or Anderson et al. (1987). The number of mammal species that should occur in Bighorn Canyon which are not documented, and the mosaic of habitat types represented in the park, has led experts to conclude the estimated presence/absence completeness for Bighorn Canyon is approximately 70% (i.e., 46 species documented out of 67 potential).

Birds

The bird inventory published in 1985 lists 212 bird species in Bighorn Canyon (Patterson 1985). Bird counts are completed on a regular basis in the park by the local Audubon Society chapter. In addition, the BLM does a mid-winter bald eagle survey that yields sightings of many raptor species. Expected habitat-bird species associations in Bighorn Canyon are reflected by the original list compiled by Patterson in 1985. The regular surveys done by the Audubon Society insure that any new species occurring in Bighorn Canyon, even incidentally, are documented. This information puts Bighorn Canyon completeness for presence/absence of bird species at or above 90 percent.

Amphibians and Reptiles

Nineteen species of reptiles and amphibians are listed in the Bighorn Canyon 1986 inventory of amphibians and reptiles (Redder 1986). Of these 19 species, 13 were documented during the 1985 field survey. The remaining species are included based on observations and guidebooks. were documented at other times and are included based on observations and guidebooks. These verified specimens indicate an estimated presence/absence completeness in the range of 70 percent.

Fish

Twenty-eight species of fish are included in the published fish survey for

Bighorn Canyon (Redder 1986). An unpublished list of fish species occurring in the park concurs with this inventory. Regular creel censuses by the Wyoming Game and Fish Department have not resulted in the addition of any new species. Given this information, presence/absence for fish species in Bighorn Canyon is estimated to be at or above 90 percent.

GRAND TETON NATIONAL PARK

Vascular Plants

Much of the species information for Grand Teton comes from Shaw (1976, 1992), and the lists include both Grand Teton and surrounding non-park areas in Teton County. Shaw (1992) lists 1,056 species in the two areas, and a very high percentage of these species are expected to occur in Grand Teton. With FY00 funds provided by the current inventory project, a more accurate checklist of vascular plants occurring within Grand Teton was developed by Stuart Markow (University of Wyoming), using specimens from several herbaria (e.g., University of Wyoming, Grand Teton, Teton Science School, and others). The checklist includes records of 894 vouchered species documented within park boundaries. The park contains a herbarium with more than 3,000 specimens representing over 1,000 species, an is entered into ANCS+. As part of the FY00 inventory effort, the herbarium and species list is currently being cross-referenced and entered into NPSpecies. The Wyoming Natural Diversity Database performed a rare plant survey in 1991-1992 (Marriott 1993). Current efforts to document and control invasive non-native plants continue to discover new invaders at the rate of one to two species per year. Considering the extensive work by Shaw and Markow, the species list for plants should approximate 90%.

Mammals

Detailed taxa-wide mammal surveys have not been performed. However, Grand Teton maintains a database of wildlife observations dating back to the 1930s. The database includes reports on 61 species. Virtually all the mammals predicted to occur in the park are included in the database, however there are reports of species that are questionable (e.g., fisher). Noticeably absent from the database are reports of bats and certain small mammals (such as shrews) predicted to occur in Grand Teton. Much research has been performed on certain small mammals through the AMK Ranch/University of Wyoming Research Center, and investigation of these reports may provide additional information on the presence or absence of these more obscure species. After consultation with mammalogists active in Grand Teton (e.g., Rick Jannett, University of Minnesota), the mammal species list approaches the 90% level; however, bats and shrews are underrepresented.

Birds

As with many national parks, Grand Teton and the surrounding area has an active birding community. In conjunction with Wyoming Game and Fish Department, Raynes (1991) lists 293 birds as occurring in Jackson Hole, which includes Grand Teton. The park wildlife observation database includes records of 299 bird species. Reports of questionable validity are followed up and submitted to the Wyoming Bird Records Committee for assessment. A number of researchers have completed studies of birds within Grand Teton (e.g. Ruszkowski 1996, Buhler and Anderson 1999), but no new species were documented. The species list for birds within Grand Teton is considered greater than 90 percent complete.

Amphibians and Reptiles

Chuck Peterson of Idaho State University has coordinated amphibian surveys in the park since 1991. These surveys have documented four of the six species known for the area listed in Koch and Peterson (1995). The two remaining species (leopard frogs and non-native bullfrogs) have been documented by observations and photographs. The amphibian species list is considered 100 percent complete, although there is considerable concern over their regional declines in distribution and abundance.

Koch and Peterson (1995) list four species of reptiles in Grand Teton. Peterson (pers. comm.) believes that one additional species (Great Basin gopher snake) may possibly occur in the south end of the park. Thus, the reptile list is approximately 80 percent complete.

Fish

Most of the species information for Grand Teton has been collected by the Wyoming Game and Fish Department, which maintains a sport fishery in the park. Current park and Wyoming Game and Fish records list 19 fish as occurring in the park, 12 native and 7 non-native (Grand Teton NP 1986, R. Hudelson, WGF fisheries biologist, pers. comm.). Certain lakes and streams have been stocked by Wyoming Game and Fish since the early 1920s. Jackson Lake is stocked with non-native lake trout, and only hatchery-reared native cutthroat trout are stocked in three additional lakes. Kelly Warm Springs have contained non-native aquarium fish (guppies, swordtails, zebra fish) since the 1960s, however due to the isolated warm springs, the species do not represent a threat to native species. Surveys of some of the small lakes have not been performed since 1931 (Grand Teton NP 1986, Hazzard 1931). In consultation with local fisheries biologists (R. Hudelson, Wyoming Game and Fish, M. Novak, Bridger-Teton NF), the list of fish species should approach the 90% level.

YELLOWSTONE NATIONAL PARK

Vascular Plants

Yellowstone's vascular plant list currently contains 1,336 taxa, comprising 1,259 species of vascular plants (Whipple 2000a, b). The park's herbarium contains over 5,000 specimens. Over 3,000 additional specimens have yet to be fully processed before they can be added to the collection. Many of these specimens document the arrival and spread of exotics, newly reported taxa, and species for which there are herbarium specimens elsewhere, but are not in the park's herbarium. An unknown number of specimens (at least several thousand) are known to be located in herbaria all over the world. Annotation with the correct identification or updates reflecting recent taxonomic treatises are being completed for the park's herbarium on an "as time is available" basis.

The current vascular plant list represents an addition of over 250 species to the last flora published for Yellowstone (Despain 1975). Current efforts to document wetlands and rare and exotic plants along roadsides and trails adds new species (primarily exotics) to the list at the rate of one to two or more species per year. Given the extensive work by Whipple, the vascular plant list is estimated to be at or above 90% complete.

Mammals

There are currently 71 species of mammals from Yellowstone NP entered into the Greater Yellowstone Network NPSpecies database with partial documentation. Large mammals such as carnivores and ungulates are well documented in Yellowstone National Park. Struebel (1989) described 54 small mammal species for the Greater Yellowstone Ecosystem. Clark et al. (1989) described 18 rare, sensitive, and threatened mammal species of the Greater Yellowstone Ecosystem. The Greater Yellowstone Network NPSpecies small mammal records for Yellowstone show that not all expected species have been adequately documented, particularly shrews, bats and rodents. Also, adequate documentation of mid-sized mammals expected for the Greater Yellowstone Area, including mid-sized carnivores such as lynx, fisher, and wolverine, does not exist.

Birds

Yellowstone National Park has had a staff ornithologist since 1987 who collaborates with numerous state and federal species-specific working groups to update park, state, and regional bird inventories and long-term monitoring databases. McEneaney (2000) documented 315 bird species that have been reliably verified and entered into an updated Yellowstone bird checklist. The bird checklist is available on the park web site at *www.nps.gov/yell*. All Yellowstone National Park bird species have been entered into the Greater

Yellowstone Network NPSpecies database with full documentation. Additionally, ongoing research at Yellowstone is comparing bird species diversity indices as a function of landscape vegetation community structure and composition patterns (e.g. Debinski et al 1999).

Amphibians and Reptiles

Yellowstone has collaborated with Dr. Charles Peterson, Idaho State University, since 1991 to support amphibian and reptile inventory and monitoring efforts. These efforts have occurred in a piecemeal fashion with support for various small grant funding sources such as Federal Highways NEPA contracts. Koch and Peterson (1995) summarized existing documentation for Yellowstone amphibian and reptile presence/absence with limited data on abundance and distribution. During the past five years, periodic surveys have been undertaken by Peterson and colleagues without an emphasis for park-wide surveys (e.g. Patla and Peterson 2000). Currently, eight amphibian and nine reptile species are entered into the NPSpecies database with only partial documentation.

Fish

Historically, Yellowstone National Park contained only five kinds of salmonid fishes (Yellowstone cutthroat trout, westslope cutthroat trout, Snake River finespotted cutthroat trout, fluvial form of Arctic grayling, and mountain whitefish) (Behnke 1992, Varley and Schullery 1998). Throughout their historical range in the western United States, native salmonids, including cutthroat trout, have been subjected to numerous human activities that resulted in widespread extirpation of populations. For some time, biologists have recognized that continued elimination of cutthroat trout populations would put the long term persistence of the subspecies in doubt, and Yellowstone cutthroat trout were designated as a “Species of Special Concern-Class A” by the American Fisheries Society. Ongoing threats to remaining Yellowstone cutthroat trout populations have generated enough concern that a formal petition to list this particular subspecies as “threatened” throughout its range was submitted to the U.S. Fish and Wildlife Service in 1998. At the present time, while this petition to list Yellowstone cutthroat trout as threatened is under review, interagency conservation plans are being developed to halt further declines in the abundance and long-term viability of the species. Longnose sucker, redside shiner, and lake chub became established in the early part of the century, presumably as the result of unauthorized introductions by bait anglers. When a 17-inch lake trout was caught in Yellowstone Lake by an angler in July 1994, park fishery biologists immediately became concerned about the future of the cutthroat trout population because this event coincided with apparent declines in abundance of cutthroat spawners in several tributaries of Yellowstone Lake. Currently, 18 native and exotic fish species are entered into the GYN NPSpecies database with partial documentation. The park believes that

knowledge of fish species presence/absence is 100%, however abundance and distribution of native and exotic species for each lake and watershed is not complete.

Selected GIS Themes for Greater Yellowstone Network Parks

Theme	*Bighorn Canyon*	*Grand Teton*	*Yellowstone*
Boundary	x	x	x
Trails		(x)	x
Roads	x	(x)	x
Structures	x		x
Geology		x	x
Soils	x	x	x
Vegetation	x	x	x
Hydrology	x	x	x
Topography	(x)		x
Fire	(x)	(x)	x
T & E Species		(x)	(x)
DOQQs[1]	(x)	x	x
DRGs[2]	(x)	x	x
Mammals Distribution		(x)	(x)
Reptile Distribution	(x)	(x)	(x)
Amphibians Distribution	(x)	(x)	(x)
Bird Distribution		(x)	(x)
Fish Distribution		(x)	(x)
Non-Natives Distribution	(x)	(x)	(x)
Wetlands		x	x

Key:
x= maps complete
(x) = maps partially complete

[1]Digital Orthophoto Quarta Quads
[2]Digital Raster Graphics

Note: A comprehensive listing of GIS maps for each park is included in the Dataset Catalogue.

Figure 8

CURRENT ONGOING RESOURCE MANAGEMENT EFFORTS AND PARTNERSHIPS

For each of the following ongoing resource management projects, park biologists will consult the Greater Yellowstone Network inventory coordinator to ensure that data will be compatible with NPS servicewide database standards. The inventory coordinator will be responsible for subsequent integration of data with the biological inventory program.

Bighorn Canyon National Recreation Area

Vascular Plants

Rare Plants of Bighorn Canyon National Recreation Area. FY98-00. Funded by the National Fish and Wildlife Foundation. This project is a rare plant inventory conducted by the Montana Natural Heritage Program and the Wyoming Natural Diversity Database. Information on the rare plant species found, as well as on other species new to Bighorn Canyon's plant list, is currently being integrated into park and servicewide databases. Information from this inventory is integral to determining future plant inventory needs.

Preliminary Mapping of Noxious Weed Species at Bighorn Canyon. FY 1998-present. $10,000 park base funds and visitor entrance fee monies. There is a continuing effort to document treated and non-treated noxious weed species infestations in Bighorn Canyon. These efforts focus mainly on known infestations in high use areas. Locations and size of infestations are spatially recorded through the use of GPS receivers. Data are made available to managers through GIS applications. Park and servicewide database management standards are being followed. This information has been used by park managers to identify areas where distribution and abundance information for targeted non-native species is needed.

Vertebrates

Bighorn Sheep Distribution and Demography. Ongoing. USGS-BRD are involved in a multi-year project to determine the distribution and causes of mortality of the bighorn sheep population in Bighorn Canyon and adjacent lands.

Grand Teton National Park

Vascular Plants

Non-Native Plant Surveys. Ongoing, $30,000 per year park funded. Focusing on 22 species declared noxious by the state of Wyoming, surveys for non-native plants are conducted in specific areas throughout the park. Infestations are mapped using GPS and GIS technology for later control efforts.

Riparian Non-Native Plant Surveys. Ongoing, $18,000 per year park funded. Riparian corridors are surveyed using standardized methods for non-native plants. Infestations are mapped using GPS and GIS technology for later control efforts.

Rare Plant Surveys Related to Planning. Ongoing, park funded. Periodic rare plant surveys are conducted in response to planning and compliance needs.

Inventory and prioritization of non-native invasive plants. Ongoing, $30,000 yearly funded by federal, state, and county agencies. The Jackson Hole Weed Management Association, comprising Grand Teton, Bridger-Teton NF, Wyoming Game and Fish Department, BLM, and Teton County, is prioritizing inventory and control efforts for non-native invasive plants in the region.

Biodiversity of Montane Meadows in the Greater Yellowstone Ecosystem. Ongoing. Principal investigator: Dr. Diane Debinski, Iowa State University. Funded in part by the University of Wyoming NPS Research Center. Vegetative sampling conducted in meadow habitats in the Grand Teton as part of a biodiversity study has the potential to locate vascular plant species not currently known for the park.

Vertebrates

Wildlife Inventory and Monitoring Program. Ongoing, $70,000 yearly park funds. Biologists from Grand Teton participate in a variety of projects assessing the distribution of sensitive species and assessment and documentation of reports of new and/or rare species. Projects include threatened and endangered species, raptors, colonially nesting water birds, and amphibians.

Bighorn Sheep Distribution and Demography. Ongoing, $75,000 park funded over three years. Biologists from Grand Teton are determining the distribution and causes of mortality of bighorn sheep in the Teton Range.

Gray Wolf Distribution and Ecology. FY00-FY02, $70,000 yearly NPS funding. Biologists from Grand Teton are determining the distribution and general ecology of newly re-colonizing gray wolves within the park.

Black and Grizzly Bear Movements and Distribution. FY00-FY02, $20,000 yearly Grand Teton funding. Grand Teton biologists are determining the movements and distribution of black and grizzly bears using GPS and radio telemetry.

Lynx Inventory in Grand Teton National Park. FY00-02, $17,000 total private and park funds. Researchers from the Wildlife Conservation Society/University of Nevada, Reno, will attempt to assess the status of lynx within the park using hair snare surveys. In addition, a cost-effective protocol for future population monitoring will be developed.

Distribution of Wolverine in Grand Teton National Park and Targhee National Forest. Ongoing, $19,000, private and federal agency funded. Private and agency biologists have trapped and installed radio transmitters in three wolverines using Grand Teton and Targhee National Forests and are determining their range and distribution.

Bison Distribution and the Effects of Brucellosis. Ongoing, $50,000 per year, USGS funded. Biologists from Grand Teton are determining the distribution of native bison as part of a study to determine the effects of brucellosis on wild, free ranging ungulates and the potential for spread of the disease to domestic livestock.

Small Mammal Inventory and Distribution. FY00-FY01, $20,000, funded by University of Wyoming Research Center. University researchers are determining the distribution of various small mammals using a variety of trapping methods.

Yellowstone National Park

Vascular Plants

Effects of Habitat Fragmentation on Exotic Plant Invasions. In progress. $12,000 funding from the Rocky Mountain CESU-Missoula, total project cost $73,200. A University of Montana Ph.D. student is determining the distribution of exotic plant invasions along the Madison to Norris road corridor and in adjacent burned areas to determine source, sink, and conduit areas for exotic plant invasions. The work is part of a larger study to look at

the relationships between exotic plant invasions and patterns of habitat fragmentation, land use, and biodiversity. The study complements in-park road corridor surveys and extends the area within which exotic plants are detected.

Interior West Resource Inventory, Monitoring, Evaluation. Ongoing. FY99 U.S. Forest Service budget was $100,000. Logistical support/incident command oversight services provided by a Yellowstone biologist. In 1999, 280 permanent forest plots were established and sampled by USDA Forest Service Rocky Mountain Research Station staff as part of an eight-state forest resource inventory. Collected field data include percent cover of understory plant species ($\geq$ 5%). Repeat surveys will provide opportunities to look for changes in species composition, especially exotic plants.

Vascular Flora of the Greater Yellowstone Area. Ongoing. Self-funded by Mr. Erwin Evert, Park Ridge, Illinois. Mr. Evert plans to publish a flora of the greater Yellowstone area. His surveys have the potential to locate vascular plant species not currently known for the park.

Biodiversity of Montane Meadows in the Greater Yellowstone Ecosystem. Ongoing. Principal investigator: Dr. Diane Debinski, Iowa State University. No NPS funding. Vegetative sampling conducted in meadow habitats in the Gallatin and Madison ranges as part of a biodiversity study has the potential to locate vascular plant species not currently known for the park.

Exotic Plant Monitoring Along Roadsides. Ongoing.
1. Principal investigator: Dr. Kenneth Meyer, Mansfield University, Mansfield, Penn. Sixty permanent transects were established along park roads in 1995. The transects are being re-read this year and future sampling provides the opportunity to look for changes in species composition, especially in exotic plants.
2. Park staff survey approximately 4,500 acres of roadside annually. Data gathered includes control efforts, location, and a qualitative estimate of exotic plant density (low to high) within 25 feet of a road. The data is stored in a Yellowstone National Park weed database and documented in the park's Dataset Catalog.

Baseline Inventory of Alpine Vegetation in the Northeast Portion of the Park. Ongoing. NPS funding: $40,000, Montana State University funding: $24,000. Alpine vegetation on 10-12 peaks in the northeast portion of the park will be characterized as part of a master's thesis project. The areas are remote and have been rarely visited by botanists. The project has the potential to locate vascular plant species not currently known for the park.

Vertebrates

Lynx Inventory at Yellowstone National Park. FY01-03. $150,000 private-sector funding through Yellowstone Park Foundation. Yellowstone biologists will conduct baseline lynx presence/absence inventory in selected primary lynx habitats across the park utilizing nationally standardized methods developed by the USFS Rocky Mountain Forest and Range Experiment Station.

Northern Yellowstone Wildlife Working Group (NYWWG). Ongoing. $15,000 per year, federal and state agency funding. The NYWWG is comprised of staff biologists from National Park Service, U.S. Forest Service, USGS-BRD and Montana Fish, Wildlife and Parks. These interagency staff biologists cost-share annual large ungulate distribution and abundance aerial surveys across the northern range of Yellowstone to update long-term inventory and monitoring databases. Survey designs incorporate standardized methodologies.

Exotic Lake Trout Abundance and Distribution. FY00-03 $220,000 per year federal funding. NRPP funding to Yellowstone is supporting ongoing sampling of the abundance and distribution of non-native lake trout in Yellowstone Lake. This exotic species is also being commensurately targeted for intensive gillnetting removals in order to lessen predation by lake trout on native cutthroat trout.

Exotic Mountain Goat Abundance and Distribution. Ongoing. $5,000 per year federal funding. Yellowstone base funding is supporting annual surveys of the abundance and distribution of exotic mountain goats in the park.

Bird presence/absence and diversity. Ongoing. Funding by the Environmental Protection Agency to Iowa State University is supporting exploratory investigations to establish correlative patterns between bird community diversity and moisture gradients that determine vegetation community composition. These studies are also generating species lists and annual bird community composition data through re-surveys of permanent plots.

Amphibian Research and Monitoring Initiative (ARMI) Inventory. FY00-02. $48,000 USGS funding. Idaho State University, Principal Investigator Dr. Charles Peterson. The current ARMI-Greater Yellowstone initiative does not include Bighorn Canyon NRA.

VI. PROJECT STATEMENTS

Project	*Park*	*Project Length*
Inventory Coordinator/Data Manager	*GS-401-11*	*3*
VASCULAR PLANTS		
Non-native Vascular Plant Inventory	*BICA, GRTE, and YELL*	*4*
Native Vascular Plant Inventory	*BICA*	*1*
Vascular Plant Inventory of Selected Alpine Areas	*YELL*	*2*
Rare Vascular Plant Inventory	*GRTE*	*1*
VERTEBRATES		
Bat Inventory	*BICA, GRTE, and YELL*	*3*
Amphibian and Reptile Inventory	*BICA, GRTE, and YELL*	*3*
Inventory of Mammals	*BICA*	*2*
Inventory of Yellowstone and Snake River Cutthroat Trout	*GRTE and YELL*	*1*
Inventory of Fish in Alpine Lakes	*GRTE*	*3*
Bald Eagle and Sage Grouse Surveys	*GRTE*	*3*

Figure 9

A summary of each inventory project follows.

NON-NATIVE VASCULAR PLANT INVENTORY

Abstract

During FY01, The Greater Yellowstone Network will hold a workshop of park staff and subject matter experts to identify the method(s) to assess relative abundance and distribution of selected non-native plants within targeted areas of the three parks. Grand Teton initiated an exotic plant relative abundance and distribution inventory in FY00 using fee demonstration funds. That methodology will be the basis for the workshop discussion of a coordinated strategy for inventory and data management within the Greater Yellowstone Network. A full study plan will be prepared by the end of FY01 based on workshop results and limited field trials, where possible. In FY02, pilot studies will be undertaken in Yellowstone and Bighorn Canyon, while the full survey design will be implemented in Grand Teton. In order to adequately characterize the abundance and distribution of non-native plants in the network parks, this project is designed as a four-year effort, with funding of $240,000. The three parks will attempt to augment funding levels to allow for adequate coverage of habitats at risk.

Principal Investigator

To be determined

Background

Non-native plant species are a significant threat to natural ecosystem processes and native plant species (Weaver and Woods 1986). Aggressive foreign plants rapidly spread in natural areas by large ungulates (including livestock in Bighorn Canyon and Grand Teton), replacing native flora and reducing habitat and available forage for wildlife and plants—including rare and endemic species (Cheater 1992). Although Bighorn Canyon, Grand Teton, and Yellowstone managers are confident in the presence/absence completeness for priority non-native plant species, there is less knowledge of the actual locations and sizes of non-native infestations. A three-park inventory project will address our lack of knowledge concerning the abundance and distribution of non-native plant species in each park.

Goal

Acquire baseline information on distribution and abundance of selected non-native plant species which are of park management concern (noxious and others) in target areas.

Objectives

Survey targeted areas (habitats and areas at risk for invasion by priority non-native plant species and areas that have not been adequately surveyed in previous efforts) to acquire baseline distribution and abundance informa-

tion on selected non-native plant species.

Produce GIS-based maps/database for each weed species' distribution that can be queried for weed management planning.

Project Sampling Strategy

Plant Species to be Surveyed. All three parks will be surveying for the weed species listed as noxious by the states in which they are located (i.e., Bighorn Canyon: Montana and Wyoming; Grand Teton: Wyoming; and Yellowstone: Montana, Wyoming, and Idaho). See Table 1. Several of the species listed are not known to be in the parks, however, they will be kept on a "watch" list and inventoried if encountered.

The parks have also identified other non-native (non-noxious) species of special concern for which they will also be surveying. These species have been chosen because they appear to be having major impacts on native plant communities. For Bighorn Canyon, those species are cheatgrass (*Bromus tectorum*) and yellow sweetclover (*Melilotus officinalis*). Grand Teton will survey for yellow sweet clover, bull thistle (*Cirsium vulgare*), common timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*), Orchard grass (*Dactylis glomerata*), mullein (*Verbascum thapsus*), and smooth brome (*Bromus inermis*). Yellowstone will survey for cheatgrass, yellow sweetclover, common timothy, and Kentucky bluegrass.

Target Areas to be Surveyed. The $240,000 currently budgeted for the relative abundance and distribution inventory is not sufficient for a 100% inventory all of the three parks. However, all three parks have ongoing programs that already have varying amounts of data. Therefore, each park has identified and prioritized the areas (management zones, habitat types, geographic areas, etc.) of highest management concern which are currently (primarily due to lack of funding) not in an ongoing program. The strategies for selection of those areas are discussed below.

Workshop/Pilot Study to Identify and Refine Sampling Strategy. During the second quarter of FY01, (January through March), the GYN inventory coordinator will convene a working group comprised of park staff and subject matter experts (identified in Appendix C) to conduct a thorough review of the exotic plant species survey methodology literature and identify the method(s). In advance of the workshop, the GYN inventory coordinator will compile existing information on non-native species at the three parks and provide these data to workshop participants. Grand Teton's inventory methodology described below will likely serve as the starting point for discussions at the workshop. A product of the workshop will be a detailed study plan that will undergo peer review and review by I&M coordinators. This study plan will include detailed task schedules, personnel needs and

major milestones. If there are funds remaining in FY01, the workshop participants may recommend some field methods development in summer 2001. A one-year pilot study in FY02 in Yellowstone and Bighorn Canyon is proposed to refine field sampling techniques and data analysis to generate per-square-kilometer cost estimates that will guide contracted field surveys. Refinement of the sampling effort can be evaluated with regard to time, costs, and amount of information obtained prior to larger-scale inventory efforts. As a result, a clearer estimate of the costs and expectations associated with broad-scale inventory efforts can be made.

Park-Specific Sampling Considerations:

Bighorn Canyon National Recreation Area. Bighorn Canyon NRA is experiencing infestations of non-native plant species in large management areas of the park. Past inventory efforts have been focused at or around the five historic ranches and visitor facilities in the park. Efforts in these areas have resulted in the informal and opportunistic identification and mapping of 150 acres of non-native plant species. Most of these species are considered noxious weeds in Montana and Wyoming or pose a specific threat to the resources of Bighorn Canyon.

Labor-intensive small-scale inventory efforts that focus on abandoned agricultural lands in and around the Yellowtail Wildlife Habitat Management Area were initiated in the summer of 2000 using park base funding. These areas are heavily infested and are prone to frequent disturbance. The 13,621-acre area is located between the Horseshoe Bend Marina and the south boundary of the park. To date, 500 acres (3.6%) of this area have been surveyed. One hundred and ninety-two of the 500 acres were found to be infested with noxious weeds. Bighorn Canyon staff will continue this effort, however, the very labor intensive inventory methods, necessitated by terrain, lack of visibility, and a long history of major infestations, are not recommended for the remainder of the park.

There are still many areas of the park where little is known about the status of non-native plant species. Approximately 17,000 acres from the lower boundary of South A and South B pastures to the Hodoo Creek area lack adequate information. Of the 17,000 acres, approximately 7,500 acres have been subjected to livestock grazing as recently as 1996. Two thousand acres are actively grazed on a bi-annual basis. Approximately 8,000 acres in this area are located in the northern-most part of the recreation area accessed through the south end of Bighorn Canyon. This area is not adequately fenced and consequently, cattle from adjacent private land and private inholdings use this area freely. Access requires leaving the park and traveling on a marginally maintained county road through several private proper-

ties. As a result, little is known about how past land use has affected the current state of the natural resources. It can be surmised from the presence of non-native vegetation on the county roadside and adjacent private land that there is a possibility non-native plant species are present. Prior to March 2000, no restrictions were in place to limit the transportation of weed infested hay through or into Bighorn Canyon. There is reason to believe hay containing non-native plant species seeds have been brought through and into the park.

Other areas of special management concern are riparian habitat associated with the streams in Bighorn Canyon. Management efforts to stop the spread of or eradicate non-native invasions in these areas has been focused on stream channels that are associated with the historic ranches or are in close proximity to the road. The status of stream reaches above and below these areas is unknown.

Grand Teton National Park. Grand Teton National Park has a weed management plan in place and works as a member of the multi-agency Jackson Hole Weed Management Association to reduce weed populations in the area and increase public awareness of the problems associated with weed infestations. Grand Teton is also a member of the Greater Yellowstone Area Noxious Weed Committee, which is made up of Grand Teton and Yellowstone national parks, and the surrounding seven national forests in the Greater Yellowstone Area. This committee works to encourage and formalize the cooperative relationship necessary for effective management and coordination of noxious weed programs among land managers.

Current survey efforts focus on the right-of-way and developed zones of the park–roads, campgrounds, domiciles, grazing lands, and river corridors. These areas are highly visible vectors of movement for exotic plants. Infestations in these areas are mapped, and many are continually treated and monitored to keep the area of infestation as small as possible. The degree of weed infestation in many of the less accessible areas of the park is not known. A lower degree of infestation in these areas is expected due to less human disturbance of soil and less human traffic transporting seed. However, these backcountry areas also contain ecosystems with the very properties that the park seeks to conserve. Additionally, many of these areas are frequented by native wildlife species whose annual migration paths take them through infested areas. The potential for seed transport by wildlife from areas of known infestation to the potentially more pristine backcountry is very high.

The purpose of Grand Teton's exotic plant inventory is to establish the location of most infestations and create distribution maps of noxious species, as well as some exotics not classified as noxious, throughout the park. This

will give resource managers a realistic view of what park resources are at risk, of the habitats that are most susceptible to species invasions, and will provide information as to the degree of invasion encountered farther away from roads and habitation sites. The information distribution maps will enable park managers to better focus their work on the reduction of known infestations and will aid in the development of additional public education programs based on accurate and complete distribution information.

Grand Teton's Draft Weed Management Plan divides the park into five weed management zones:
• Riparian (river corridors – Snake River, Gros Ventre River, Spread, Pacific, Ditch and Pilgrim Creeks)
• Right of Way (roadways)
• Developed (maintenance, housing, concession and campground areas)
• Valley (including trails, untrailed, and historic use areas)
• Backcountry (trailed and undeveloped backcountry areas, as well as cabin sites)

The park has adapted four survey types that were developed and described by USDA Forest Service Region 6 (Scott Riley, Pacific Northwest Region Botanist; pers.comm), and are currently in use by Region 6 forests for plant inventory surveys:

1. Intensive survey – A survey in which virtually every square meter of the target area is searched for the target species. This technique has been used, and will continue to be used in the developed zone of the park.

2. Intuitive controlled survey – A survey in which the area of interest is surveyed less intensively, often using a zig-zag pattern, with locations of particular interest receiving additional attention at the discretion of those conducting the survey. This technique has been used in conducting the FY00 survey of Grand Teton National Park's riparian corridors.

3. Transect survey - For medium to large areas with potentially significant levels of infestation, transect surveys will be conducted. These may also incorporate an aspect of the intuitive controlled technique in that areas of higher probability may receive closer attention, or travel of short distances off the transect for closer inspection. Large areas of the valley zone, and some of the backcountry zone may best be surveyed this way.

4. Spot survey – Medium to large areas with anticipated low levels of infestation may be surveyed using spot surveys wherein the surveyor will look closely at small areas within the larger area. The spot survey locations may be based on accessibility, likelihood of infestation, or may be randomly selected if all areas are equally accessible and have similar perceived likeli-

hood of infestation. Areas of the valley zone and backcountry zone that are far from human influence and have no history of weed infestations may be surveyed this way.

Grand Teton National Park uses the Montana Noxious Weed Survey and Mapping System technique found in the *Weed mapping Handbook* Version 2.0 (*www.montana.edu/places/mtweeds*) for recording inventory results.

Grand Teton National Park began surveying the riparian areas in FY00, using fee demo funds. The right of way and developed zones are targeted for survey by park personnel in FY01. The focus areas for the inventory, distribution and abundance data to be collected as part of this GYN proposal will be sensitive areas in the backcountry and valley zones. These sensitive areas consist primarily of:

1. Wet meadows throughout Grand Teton
2. Subalpine meadows (8,000-9,200 feet)
3. Alpine meadows (above 9,200 feet)
4. Low elevation (6,000-8,000 feet) meadows in the northern portion of Grand Teton
5. Aspen stands throughout Grand Teton

Valley Zone—The valley zone includes numerous historic ranch and dude ranch sites as well as currently active grazing allotments. Regeneration on the historic sites consists of both native and exotic species, while continued ground disturbance on the existing allotments provide soil conditions that favor further expansion of weed infestations. Relatively low elevations and dry conditions characterize this zone, which includes much of the habitat within the park that best suits most noxious weed species. While much of the area has received heavy human impact, there are also large acreages that receive little human use, particularly in the vicinity of the Potholes, and in the northern portions of the park.

Characteristics: Large infestations on historic sites. Trailside infestations likely resulting from high levels of use by horses and wildlife. Numerous areas of disturbed ground resulting from human activities past and present, and from wildlife use, including bison wallows.

Anticipated Findings: Large acreage infestations in historic areas, as well as along trails, and in areas that have been disturbed by humans, domestic animals, or wildlife.

Inventory Strategy: Areas of historic use and trails will be surveyed extensively. Off-trail areas will be surveyed from moderate to high intensity depending on the degree of infestation found on nearby trails and on proximity to high infestation sites.

Inventory Techniques: Historic sites will be inventoried using the intuitive controlled technique. Trails will be traveled and surveyed using intensive techniques along the trails, and intuitive controlled searches in areas surrounding the trails. Off-trail areas will be divided into sections based on habitat type and probability of infestation. These segments will be surveyed using intuitive controlled, transect, and spot survey techniques. The wet meadows and aspen stands of the valley are target areas for this proposal and would be surveyed using the intuitive controlled technique.

Backcountry Zone—The backcountry zone is the largest area of the park, is assumed to be the least invaded by exotic species, but is the least surveyed of the zones. Trails lead up most park canyons from 6,500 to 11,000 feet or more. These trails provide easy passage for noxious seeds transported by humans or stock animals. Fortunately, most of the noxious weed species in the park are unlikely to be found above about 8,500 feet due primarily to unfavorable abiotic conditions. Between the valley floor and the 9,000 foot level however, it is likely that numerous small infestations occur resulting from transport of seed by humans, animals, and wind. Riparian areas surrounding high to moderate elevation streams may be particularly susceptible to weed infestation due to heavy animal use resulting in soil disturbance and seed transport. Above 9,000 feet, several meadows receive intensive use by climbers and backpackers. The possibility of new invasions due to seed transport from other alpine or subalpine sites frequented by these backcountry users must be explored. If backcountry infestations are located before they become large, the chance of reducing, containing, or eradicating them is relatively high.

Characteristics: Small infestations on sites frequented by humans, stock, and wildlife are anticipated. Since most disturbances are either small or naturally infrequently occurring, the availability of bare ground or good seedbeds for noxious weeds may be low. Higher elevation communities may be very sensitive to invasion, however, and the extent of weeds present is unknown. Disturbances relating to visitor use such as camping in the park's camping zones may be significant.

Anticipated Findings: Expect small infestations centered on campsites and backcountry cabins. Mid-elevation meadows may be very susceptible to infestation, with numerous seed sources including stock, historic use, and wildlife. Wildlife bedding areas and stream-sides may be prone to invasion.

Inventory Strategy: Trails, cabins and campsites will be surveyed extensively by the park's crew. Off-trail and higher elevation areas will be stratified base on habitat type and proximity to known infestations, then surveyed in accordance with the perceived likelihood of infestation. This will include an

intuitive controlled survey of the subalpine and alpine meadows, to be conducted as part of this proposal, and transect or spot surveys of less sensitive areas, such as conifer forests, also to be conducted as part of this proposal.

Inventory Techniques: Trails, cabins, and heavy use campsites will be surveyed intensively using the intensive or intuitive controlled technique. Areas in close proximity to trails, cabins, and campsites will be surveyed using the intuitive controlled survey. Areas farther from trails and those with low visitor use will be surveyed using the transect and/or spot survey techniques. In the backcountry zone, careful records and maps of areas surveyed and the intensity with which they are surveyed will be kept. Areas that are not covered due to time, weather, or flowering season constraints will be slated for future inventory work based on habitat type and proximity to known infestations.

Yellowstone National Park. Like Grand Teton National Park, Yellowstone has a draft *Exotic Vegetation Management Plan* (NPS 1997) that guides its approach to exotic plant management. Over 4,500 acres, primarily along roadsides and in developed areas, are surveyed annually in early detection efforts with emphasis placed on eradicating small, new infestations of highly invasive species. Control efforts currently focus on 32 of the 180+ non-native plants in Yellowstone, most of which are listed as noxious in Wyoming, Montana, and/or Idaho.

Yellowstone is also a member of the Greater Yellowstone Weed Management Committee, and has developed a computerized database following the committee's *Guidelines for Coordinated Management of Noxious Weeds in the Greater Yellowstone Area* (Free et al. 1990), to monitor weed management efforts. Beginning in 1993, several aspects of management actions and weed conditions were recorded in a standardized spreadsheet on an annual basis. Most information derived from the database has been for administrative purposes—i.e., quantifying the amount of time, money, and effort put forth by park personnel in weed management. Few attempts have been made to use the database to quantify weed problems or describe characteristics of weed populations throughout the park.

Due to lack of funding, there has been no consistent attempt to quantify or map exotic plants away from roadsides or developed areas. In the forested, higher elevation regions of the park, particularly backcountry areas, little evidence currently exists that exotic vegetation is having significant negative impacts on native plant communities across a broad landscape scale. In the lower and drier areas of the park, known as the northern range, however, historical evidence of exotic plant establishment and escapes has been documented. Early exotic vegetation management efforts in these areas were discontinued because of perceived ineffectiveness. Subsequently, no

efforts were made to map the rate or extent of infestation. As such, broad geographic areas are believed to now contain many exotic/noxious weed species. As identified in Yellowstone's draft *Exotic Vegetation Management Plan*, the need exists to delineate the range of such species and implement control/containment strategies to prevent further spread into the higher elevation regions of the park.

The focus for the inventory, distribution and abundance data to be collected as part of this GYN proposal will be the 122,000 acres of non-forested lands in the northern portion of the park known as the northern range. The large acreage, coupled with the desire to focus on controllable or containable infestations of multiple species of varying infestation size and cover make the proper inventory design crucial for success. It is for that reason that we wish to hold a workshop of subject experts to refine inventory design and to better define the amount of work that can be accomplished.

A possible design for a pilot study would include the identification of a 10 km x 10 km sampling area superimposed on the landscape and encompassing a mixture of stratified units of northern range non-forest habitat types (already mapped and stored in a GIS format). Within the sampling area, transects would be spaced 1 km apart along a north-south direction, and a temporary 314 m^2 sampling plot (10 m radius) would be established every 0.5 km along the transect. GPS technology would be used to locate sampling plots as well as record travel along each designated transect. Within each sampling plot, each exotic plant species of concern (approximately 25 different species) would be noted as to presence and assigned a qualitative value reflecting species abundance (1= 1 plant or potentially flowering stem; 2= 2-10 plants; 3= 11-100 plants; 4= 101-1000 plants; 5 = 1001-10,000 plants; etc.). Refinement of the sampling effort would be evaluated with regard to time, costs, and amount of information obtained prior to larger-scale inventory efforts scheduled to start FY02. As a result, a clearer estimate of the costs and expectations associated with broad-scale inventory efforts would be made.

Partnership Opportunities

Inventory efforts will complement current Bighorn Canyon, Grand Teton, and Yellowstone resource management activities, with coordination between the I&M program and WASO-BRMD (possibly with the EPMT program).

Implementation Plan

The experts workshop will be organized by the GYN inventory coordinator. The detailed study plan produced by workshop participants will be peer-reviewed. If planning proceeds rapidly and there are funds remaining in

FY01, we recommend that some methods be field-tested in summer 2001. FY02 fieldwork is likely to include full-scale surveys in Grand Teton, with pilot studies in Yellowstone and Bighorn Canyon. The fieldwork will be coordinated by GYN permanent staff, assuming that the network will hire a plant ecologist in FY02 with base funding provided as part of the vital signs monitoring effort. Fieldwork will be accomplished by seasonal biological technicians supervised by park natural resource staff, with coordination and training provided by the GYN plant ecologist. The network parks will provide logistical support and housing, when available, to field teams. Data management and curation will be coordinated by the GYN inventory coordinator/data manager.

Products

This project will update presence/absence lists and generate abundance and distribution information for selected non-native vascular plants (noxious weeds and those of management concern that may or may not currently be listed as noxious) in targeted areas in each of the GYN parks. The principal investigator(s) will provide annual reports, a final report, Arcview GIS themes, and an MS Access database of all information collected during the project. The GIS themes will document abundance and distribution of all targeted species. The MS Access database will include data that documents each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens and detailed photographs for any newly identified species or those species with marginal documentation will be provided in accordance with the guidelines in the documentation chapter. This documentation will include information on the time of collection, location, collector, and site notes. The inventory coordinator will ensure that project findings are updated in the Servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The principal investigator will provide metadata in accordance with FGDC standards.

Project Budget

Non-Native Vascular Plant Inventory	FY01	FY02	FY03	FY04	Total
Salary	$5,000	$55,000	$55,000	$55,000	$170,000
Travel/Per Diem	4,000	12,000	12,000	11,000	39,000
Supplies	1,000	5,000	5,000	5,000	16,000
Misc.		5,000	5,000	5,000	15,000
Total	**$10,000**	**$77,000**	**$77,000**	**$76,000**	**$240,000**

Noxious Weeds in Idaho, Montana, and/or Wyoming

Aegilops cylindrica (ID)	jointed goatgrass
Ambrosia tomentosa (ID, WY)	skeleton bursage
Actium minus (WY)	common burdock
Cardaria chalepensis (MT, WY)	whitetop
Cardaria draba (ID, MT, WY)	hoary cress
Cardaria pubescens (MT, WY)	hairy whitetop
Carduus acanthoides (WY)	plumeless thistle
Carduus nutans (ID, WY)	musk thistle
Centaurea diffusa (ID, MT,WY)	diffuse knapweed
Centaurea maculosa (ID, MT,WY)	spotted knapweed
Centaurea pratensis (ID)	meadow knapweed
Centaurea solstitialis (ID, MT)	yellow starthistle
Centaurea repens (ID, MT,WY)	Russian knapweed
Chondrilla juncea (ID, MT)	rush skeletonweed
Chrysanthemum leucanthemum [Leucanthemum vulgare] (MT, WY)	oxeye daisy
Cirsium arvense (ID, MT, WY)	Canada thistle
Conium maculatum (ID)	poison hemlock
Convolvulus arvensis (ID, MT, WY)	field bindweed
Crupina vulgaris (ID, MT)	common crupina
Cynoglossum officinale (MT, WY)	houndstongue
Cytisus scoparius (ID)	Scotch broom
Elytrigia repens [Agropyron repens] (WY)	quackgrass
Euphorbia dentata (ID)	toothed spurge
Euphorbia esula (ID, MT, WY)	leafy spurge
Hieracium aurantiacum (ID, MT)	orange hawkweed
Hieracium caespitosum (ID, MT)	meadow hawkweed
Hieracium floribundum (MT)	yellow-devil hawkweed
Hieracium piloselloides (MT)	kingdevil hawkweed
Hyoscyamus niger (ID)	black henbane
Hypericum perforatum (MT)	common St. Johnswort
Isatis tinctoria (ID, MT, WY)	dyer's woad
Lepidium latifolium (ID, WY)	perennial pepperweed
Leucanthemum vulgare (WY)	oxeye daisy
Linaria dalmatica (ID, MT, WY)	Dalmatian toadflax
Linaria vulgaris (ID, WY)	yellow toadflax
Lythrum salicaria (ID, MT, WY)	purple loosestrife
Milium vernale (ID)	spring millet grass
Nardus stricta (ID)	moor matgrass
Onopardium acanthium (ID, WY)	Scotch thistle
Potentilla recta (MT)	sulfur cinquefoil
Ranunculus acris (MT)	tall buttercup

Senecio jacobaea (ID, MT)	tansy ragwort
Solanum elaeagnifolium (ID)	silverleaf nightshade
Solanum rostratum (ID)	buffalobur
Sonchus arvensis (ID, WY)	perennial thistle
Sorghum halepense (ID)	Johnsongrass
Tamarix chinesis (WY)	Chinese tamarisk
Tamarix parviflora (WY)	saltcedar
Tamarix ramosissima (MT, WY)	saltcedar
Tanacetum vulgare (MT)	common tansy
Tribulus terrestris (ID)	puncturevine
Zygophyllum fabago (ID)	Syrian beancaper

*List compiled from USDA Agricultural Research Service Invaders Database list of noxious weeds in Idaho (last updated on 3/12/99), Montana (last updated on2/14/00) and Wyoming (last updated on 4/19/00). *http://invader.dbs.umt.edu/*

BIGHORN CANYON NATIVE VASCULAR PLANT INVENTORY

Abstract

This inventory will be conducted through use of a sole source justification for non-competitive procurement. A template of the form will be completed by the Greater Yellowstone Network steering committee representative from Bighorn Canyon prior to January 2003. At that time the principal investigators, the Greater Yellowstone Network coordinator and the Bighorn Canyon network steering committee member will develop a detailed study plan.

Principal Investigators

Walter Fertig, Wyoming Natural Diversity Database
Bonnie Heidel, Montana Natural Heritage Program

Background

The most current tally of vascular plants in Bighorn Canyon National Recreation Area totals 776 species (Heidel and Fertig 2000). This number includes 70 formerly unknown species documented during rare plant field inventories conducted during 1998 and 1999 by the Montana Natural Heritage Program and the Wyoming Natural Diversity Database. These additional species represent approximately 10% of the total currently known vascular plant species in Bighorn Canyon. Management recommendations from Heidel and Fertig (2000) include the need to further inventory Bighorn Canyon for plant species.

This recent increase in plant species numbers and other background information on Bighorn Canyon National Recreation Area was presented last May to a panel of botanists and range managers during the Greater Yellowstone Network Inventory Workshop in Bozeman. These persons included Bonnie Heidel of the Montana Natural Heritage Program; Walter Fertig of the Wyoming Natural Diversity Database; Jennifer Whipple, Roy Renkin, and Mary Hektner of Yellowstone National Park; Kelly McCloskey and Steve Haynes of Grand Teton National Park; Suzanne Morstad of Bighorn Canyon National Recreation Area; and Don Despain of the USGS. Large knowledge gaps and an incomplete list of vascular plant species were obvious to the participants. Adequate plant inventories in vulnerable habitats (i.e., riparian corridors and cushion plant communities), remote areas (i.e., cliff habitat and dry land canyons), and habitat with small representation (i.e., seep wetlands) have not been completed. Results of the workshop show Bighorn Canyon is below the servicewide target of 90% presence/absence completion. Those who attended the inventory workshop approximated the completeness of the vascular plant presence/absence species list at 75%.

Goal

Gain reliable baseline information on vascular plant species composition by fulfilling the servicewide goal of 90% presence/absence information for vascular plant species in Bighorn Canyon National Recreation Area.

Objective

Document species presence/absence in vulnerable habitats, remote areas, and areas where past efforts have not been focused.

Project Sampling Strategy

Objective 1: The strategy for increasing the presence/absence vascular plant species list to 90 percent at Bighorn Canyon will be similar to the strategy used in 1998 and 1999 during the rare plant inventory. This strategy, a systematic rare plant survey, increased the Bighorn Canyon vascular plant list by 10 percent. By adopting this systematic survey to target specific areas, botanists are confident the 90 percent completeness for presence/absence of vascular plant species will be fulfilled. Work for this inventory will be contracted to non-Park Service subject matter experts.

The first step to this systematic ground survey will require identification of areas to be targeted. Preliminary consultation has resulted in a list of areas that have the potential to yield additional vascular plant species in Bighorn Canyon. These areas are: 1.) Limestone cliffs of the main canyon and side streams; 2.) Cold water stream riparian habitat in the north area of the park; 3.) Spring and seep wetland habitat; and 4.) Marsh and forest habitat at the south end of the park. These areas will be mapped using current knowledge of park staff and researchers familiar with the park, outside park resources, USGS topographic maps, existing GIS coverages (vegetation, hydrology, and topography), aerial photo quads, and any published reports available. The resulting map will allow researchers to prioritize and plan-specific sampling methods for each area based on area attributes and the potential species that may occur.

This work will occur prior to the non-native vascular plant inventory also being proposed. In addition to the new species identified and documented, any infestations of non-native vascular plant species will also be noted and mapped. This information will be made available to persons conducting the non-native vascular plant inventory for Bighorn Canyon.

Partnership Opportunities

Inventory efforts will complement the recent rare plant work conducted in the park in 1998-1999 by Bonnie Heidel and Walter Fertig. Areas that were adequately surveyed for rare plants and yielded new species do not need to be priority targets for this inventory, which will allow more effort to go to

remaining high priority areas. There will also be a direct link between this project and the non-native vascular plant inventory proposed in this study plan. The location of any non-native vascular plant species found will be available to persons conducting the non-native inventory. The presence or absence of non-native vascular plant species in areas may preclude them from the non-native survey and allow a better focus on other areas.

Implementation Plan

The Greater Yellowstone inventory coordinator and the steering committee will issue a request for proposals. The success of this project will be a direct result of having knowledgeable botanists, preferably with experience in Bighorn Canyon, in the field doing the inventory.

Contracted personnel will be responsible for organizing any resource material that exists outside of Bighorn Canyon. Bio-techs, under the direction of the inventory coordinator and in cooperation with Bighorn Canyon staff, will assist contracted personnel with organization of in-park resource materials. Field activities necessary to survey the targeted areas will be completed over one field season. Contracted personnel will conduct fieldwork under the direction of the inventory coordinator. Bighorn Canyon will provide logistical support (transportation by boat to remote areas, camping spaces, etc.).

Deliverables

This project will generate an updated presence/absence list of vascular plant species occurring in Bighorn Canyon National Recreation Area that reflects the servicewide target of 90% completeness. The principal investigators will provide a final report as an addendum to the rare species report completed in 2000 for the purpose of summarizing Bighorn Canyon flora. ArcView GIS themes will be provided for locations of species that are of management concern. The GIS themes will document the location of new species along with the locations of rare species, species in fragile habitats, and species occurring in areas that are likely to be impacted by human activities. An MS Access database of information necessary to complete NPSpecies database forms for all new voucher specimens will be provided. The MS Access database will include data that documents each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens for any newly identified species or species with marginal documentation will be provided in accordance with the guidelines in the documentation chapter. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases, including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The principal investigator will provide metadata in accordance with FGDC standards.

Project Costs

Vascular Plant Inventory (BICA)	FY01	FY02	FY03	FY04	Total
Salary	$5,552				$5,552
Travel/Per Diem	3,144				3,144
Supplies					
Misc. (15% overhead)[1]	1,304				1,304
Total	**$10,000**				**$10,000**

[1] Note: Estimated indirect cost associated with subject matter expert at the University of Wyoming.

VASCULAR PLANT INVENTORY OF SELECTED ALPINE AREAS IN YELLOWSTONE NATIONAL PARK

Abstract

Yellowstone's botanist, with assistance from one seasonal employee and knowledgeable volunteer botanists will, over two field seasons, conduct a systematic survey of vascular plants (presence/absence and distribution and abundance of exotic and rare plants) in the alpine zone of the Gallatin Range of Yellowstone National Park.

Principal Investigator

Jennifer Whipple, botanist, Yellowstone National Park

Background

The vascular plant flora of Yellowstone National Park has been studied extensively since the park's establishment in 1872, but most of the attention has been directed at areas relatively close to established roads. This bias has resulted in the alpine flora being generally neglected. Extensive areas in the alpine zone have apparently never been surveyed for the presence of vascular plant species. Within Yellowstone, the least investigated areas in the alpine zone include the Gallatin Range, the Two Ocean Plateau area, and the southern Absarokas.

The Gallatin Range is the highest priority for survey since this range is predominantly composed of sedimentary rocks including some areas of limestone, unlike most of Yellowstone. Alpine limestone areas in other ranges of the Greater Yellowstone Area have been found to have unique endemics and arctic/alpine plants that are significantly disjunct from the main portion of their ranges. Botanical surveys during the latter part of the nineteenth century and the early twentieth century in this area were opportunistic, sporadic, and incomplete. Botanical surveys in recent years have been extremely limited due to access restrictions, implemented for human safety and grizzly bear management purposes, over a large portion of the range.

The need to survey the alpine area in the Gallatin Range is made more urgent due to the movement of non-native mountain goats into Yellowstone from adjacent areas. In other areas such as Olympic National Park, the introduction of mountain goats into areas previously not inhabited by goats has resulted in major impacts to the alpine flora (Houston et al. 1986). It is important to have a baseline inventory of areas such as the Gallatin Range now, while the goat population is small.

Goal

Ensure that the park meets the NPS servicewide Inventory and Monitoring Program's goal to document the occurrence of at least 90 percent of all vascular plants in Yellowstone through baseline, systematic surveys of remote, little visited alpine areas of the park.

Objectives

1. Document species presence/absence in habitats that have not been previously sampled or are under-sampled.

2. Document species distribution and abundance of plant species of special concern (i.e., rare plants) or other plant species of management interest (specific exotic plants).

Project Sampling Strategy

Objective 1: The park's botanist, who has extensive knowledge of the park's flora, will lead a field crew of a seasonal employee and other knowledgeable botanists (primarily volunteers) in a systematic survey of alpine areas in the Gallatin Range. Since the focus of interest in this study is in the documentation of presence/absence information in an under-sampled area of the park, the sampling strategy will prioritize areas most likely to contain species previously unreported in the park. Highest priority will be given to documenting plant species occurrences in sedimentary rock areas (especially limestone) at elevations greater than 9,500 feet, an area of approximately 5,000 acres. Lower priority will be given to areas between 9,000 and 9,500 feet elevation, an area of approximately 8,400 acres.

The mountain range will be divided into segments from north to south. Using orthophotquads, geologic maps, and GIS information, the area will be prioritized for field work. Accessibility will also influence the choice of areas to focus on. The highest priority will be areas of limestone at elevations greater than 9,500 feet, including scree fields primarily composed of limestone. All other bedrock types above 9,500 feet will also be visited, but not as intensely. The choice of field routes and base camps will be focused on ensuring adequate representation of different aspects and moisture regimes, and any areas that appear unusual. The time spent in various areas will be directly influenced by the prevalence or lack of unreported species, species of special concern, and exotic species.

Objective 2: Document distribution, ecological parameters, population size, and phenology of any species present which are on the Montana or Wyoming plant species of special concern lists or the Idaho Native Plant Society rare plant list. Population size will be directly counted if only a few individuals are present, otherwise ten one-square-meter plots will be located randomly within the population, individuals within the plots counted, and the size of

the area occupied determined by GPS, allowing a population estimate to be made.

Objective 3: Document distribution and population size of exotic plant species of special management interest (i.e., timothy, sweet clover, Dalmation toadflax, leafy spurge, butter and eggs, Kentucky bluegrass, cheat grass, and thistles). Note: we do not expect to find these species in the high alpine zone, however, if they are present, they will be documented for inclusion in the GYN non-native plant inventory database.

Partnership Opportunities

Several knowledgeable botanists have expressed an interest in being a part of a work group (led by Yellowstone's botanist) that would receive special permission to visit this little known area. These botanists are employees of universities, other federal agencies, and various state natural diversity database and natural heritage programs. Information collected for the park would provide additional information for their areas of responsibility.

Implementation Plan

The park's botanist will direct fieldwork. A seasonal employee will aid with the logistics and preparation of voucher specimens. Access to the area would be through a combination of horseback and helicopter. The park would provide food and in-park transportation for all field persons, including volunteer botanists. Backcountry cabins would be used where appropriate; permission for camping in non-designated campsites would be sought to minimize travel time to remote sites. Field activities would occur in two two-week periods over two field seasons.

Deliverables

This project will generate an updated presence/absence list of alpine plant species occurring in Yellowstone National Park. The principal investigator will provide annual reports, a final report, and an MS Access database of all information collected during the project stored on CD media. The principal investigator will work with the coordinator to create ArcView GIS themes that document the location, abundance, and habitat characteristics of new species and species on the Montana or Wyoming plant species of special concern lists or the Idaho Native Plant Society rare plant list. The MS Access database will include data documenting each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens and detailed photographs for any newly identified species or species with marginal documentation will be provided in accordance with the guidelines in the documentation chapter. This documentation will include information on the time of collection, location, collector, and site notes. The Greater Yellowstone Network coordinator will ensure that project findings are updated in the servicewide biological data-

bases, including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The inventory coordinator will create metadata in accordance with FGDC standards.

Project Cost

Total cost is $10,000 over two years; $5,000 for each of two two-week field seasons. The primary costs would be related to logistics – helicopter and horseback travel to remote sites. Two pay periods of a seasonal GS-06 employee would be paid each of the two seasons.

Alpine Vascular Plants Inventory (YELL)	FY01	FY02	FY03	FY04	Total
Salary			$1,650	$1,650	$3,300
Travel/Per Diem			350	350	700
Supplies					
Misc. - Helicopter			3,000	3,000	6,000
Total			**$5,000**	**$5,000**	**$10,000**

GRAND TETON RARE VASCULAR PLANT INVENTORY

Abstract

A newly described vascular plant species, *Stephanomeria fluminea* (Teton wire-lettuce), is known to occur in Grand Teton National Park. During one field season, a survey would be conducted to determine the location, distribution, and status of this potentially rare species within the park. This project will use contracted personnel and cost $5,000.

Principal Investigator

To be determined, likely to be through a sole-source contract or cooperative agreement with the University of Wyoming.

Background

Stephanomeria fluminea is a newly described species only known to exist from northwestern Wyoming near Jackson Hole and along the upper reaches of the South Fork of the Shoshone River (Gottlieb 1999). This species is restricted to impermanent, slightly raised, cobble benches in the flat, gravelly beds of creeks that flood and churn after spring snow melt (Gottlieb 1999). Currently, *Stephanomeria fluminea* is known to occur in Grand Teton National Park, but the exact distribution within the park of this localized endemic is unknown. Extensive surveys for *Stephanomeria fluminea* are necessary in order to determine the status and rarity of this species.

Goal

Determine the location, distribution, and status of *Stephanomeria fluminea* in Grand Teton National Park.

Objectives

1. Survey gravelly creek/river drainages throughout Grand Teton National Park for the presence of *Stephanomeria fluminea*.

2. Document location, distribution, ecological parameters, population size, phenology, and potential threats for each site located.

Project Sampling Strategy

Currently, *Stephanomeria fluminea* is known to occur near Pilgrim Creek, Pacific Creek, Spread Creek, and the Snake River (Whipple pers. comm.; Gottlieb 2000). Surveys would be conducted along all of the major creeks and rivers (approximately 15 miles) with the appropriate habitat of raised cobble benches along gravelly beds of creeks/rivers.

Partnership Opportunities

The status of *Stephanomeria fluminea* in the Bridger-Teton National Forest is also currently unknown. The possibility of combining the status survey with a similar project within the national forest would provide additional information on the rarity of this species. The addition information would help determine the appropriate level of conservation concern for this recently recognized species.

Implementation Plan

Field efforts will be conducted by contracted personnel under the direction of the Greater Yellowstone Network inventory coordinator. Contracting will be either through sole source or through a University of Wyoming cooperative agreement, and preliminary contracting efforts have begun. Grand Teton National Park will support activities by providing logistical support such as boat transportation and the use of backcountry facilities as available. Field activities will occur over one field season.

Deliverables

This project will generate a distribution and abundance map of *Stephanomeria fluminea* in Grand Teton National Park. The principal investigator will provide a final report and an MS Access database of all information collected during the project stored on CD media. The report will document the status of *Stephanomeria fluminea*, including locations, distribution, ecological parameters, population size, phenology, and potential threats for each site located. The principal investigator will work with the inventory coordinator to create ArcView GIS themes that document the distribution, population size, and habitat characteristics of *Stephanomeria fluminea*. The MS Access database will include data documenting each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens and/or details of major populations will be provided to the Grand Teton National Park herbarium in accordance with the guidelines in the documentation section. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The GYN coordinator will create metadata in accordance with FGDC standards.

Project Cost

The status survey for *Stephanomeria fluminea* would cost $5000 and would be conducted over one year by contracted personnel.

GRTE Rare Plants	FY01	FY02	FY03	FY04	Total
Salary	$3,300				$3,300
Travel/Per Diem	1,000				1,000
Supplies	100				100
Misc.	600				600
Total	**$5,000**				**$5,000**

BAT INVENTORY

Abstract

During winter 2000-2001, the Greater Yellowstone inventory coordinator will issue a request for proposals for a three-year (FY02-04) investigation to conduct baseline presence/absence inventories of bat species that utilize native habitats and park structure roosts at Bighorn Canyon National Recreation Area, Grand Teton National Park, and Yellowstone National Park. Sampling designs will incorporate preliminary species lists and roost distribution information at Yellowstone and Grand Teton national parks arising from previous Integrated Pest Management investigations conducted during the past decade by the USGS–Midcontinent Ecosystem Science Center. Survey and sampling designs will strongly complement established methodologies developed by the Montana Natural Heritage Program and the Wyoming Game and Fish Department arising from a recent Wyoming statewide bat inventory program.

Principal Investigator

To be determined

Background

Little comprehensive parkwide information is currently available on bat species richness, abundance, and distribution in the Greater Yellowstone Network parks. Indeed, the most recent comprehensive account of mammals in Wyoming provided only three records for bats in GYN parks, with another six species predicted but unconfirmed (Clark and Stromberg 1987). Generally, needs for information regarding bat species richness, distribution, and abundance at the GYN parks has arisen through Integrated Pest Management (IPM) concerns due to guano accumulation in park structures. Bogan and Geluso (1999) investigated attic temperature versus bat abundance relationships in park structures at Yellowstone and Grand Teton national parks in order to provide information for development of non-lethal IPM strategies. In addition to habitat description, these investigations also generated ancillary but acknowledged incomplete species lists.

Otherwise, species lists have been generated only piecemeal in response to NEPA compliance concerns. Indeed, Bogan and Geluso (1999) documented only one species (*Myotis licifugus*, little brown bat) but suggested strongly that a total of eight species were thought to have occupied park structures investigated at Yellowstone and Grand Teton national parks. Additionally, NEPA compliance surveys reported by Martinez (1999) along road corridors at Yellowstone National Park reported six species along the Mammoth-to-Norris segment of the Grand Loop road. However, Martinez captured and visually identified only one species, *Corynorhinus townsendii* (Townsend's

big-eared bat). Subsequent NEPA compliance surveys conducted along this same road stretch generated four tentatively identified species with two additional unidentified species observed (Hendricks 2000).

Goal

Given the paucity of reliable knowledge regarding bats as described above, it is a priority objective of the Greater Yellowstone Network to establish benchmark bat species presence/absence information.

Objectives

1. Targeted species surveys – Document presence/absence of bat species of special Integrated Pest Management concern that are suggested to occupy an array of historic park structures in all three GYN parks based on historic records, but for which current substantiated records are lacking.

2. Systematic surveys – Document species presence/absence in key native habitats based on historic records but for which current substantiated records are lacking.

Project Sampling Strategy

Objectives 1 and 2: Given the difficulties encountered in species identification and sampling previously encountered in non-inventory sampling, the sampling strategy for multi-park baseline bat inventories should utilize multiple sampling techniques (see Thomas and West 1989, O'Farrell and Gannon 1999) to assure the most complete assessment possible. At this time, sampling is expected to include both acoustic echolocation (sensu O'Farrel et al. 1999) utilizing detector units (consisting of an ultrasound detector, timer/tape-driver, and a voice-activated cassette recorder and capture techniques) placed over selected habitats (e.g., water bodies, meadows, cliff faces, under or near bridges, forest corridors). Capture techniques will likely utilize standardized mist netting at selected habitats. Captured individuals will be sexed, aged, measured (forearm, weight), reproductive status noted, and then will be released. Due to a general lack of historical species information at Bighorn Canyon, more extensive surveys may be required to provide adequate benchmark presence/absence information to the 90th percentile objective.

Partnership Opportunities

Inventory efforts will expand on and complement data collection activities previously funded by Federal Highways Administration and USGS-Midcontinent Ecosystem Science Center. Inventory efforts will also expand upon and be reconciled with Wyoming's statewide bat inventory program conducted by the Wyoming Game and Fish Department that did not include national parks.

Implementation Plan

Field efforts will be conducted by contracted personnel under the direction of the Greater Yellowstone Network inventory coordinator. Individual network parks will support activities by providing logistical support such as boat transportation and use of backcountry facilities as available. Field activities will occur over three seasons (2002-2004) in order to provide adequate time for survey efforts and to allow for some annual environmental variability which may affect sampling conditions and population/distribution parameters. Based on feedback provided at the Greater Yellowstone workshop in Bozeman, it is expected that the Montana and Wyoming natural heritage programs will submit proposal bids for the inventory contracts.

Deliverables

This project will generate an updated presence/absence list and distribution maps of bat species occurring in Bighorn Canyon, Grand Teton, and Yellowstone. The principal investigator will provide annual reports, a final report, and an MS Access database of all information collected during the project stored on CD media. The principal investigator will work with the inventory coordinator to create ArcView GIS themes that document the location, abundance, and habitat characteristics of all bat species found during the survey. The MS Access database will include data documenting each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens and/or detailed photographs for any newly identified species or species with marginal documentation will be provided in accordance with the guidelines in the documentation section. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The GYN coordinator will create metadata in accordance with FGDC standards.

Project Costs

Bat Inventory	FY01	FY02	FY03	FY04	Total
Salary		$6,000	$15,000	$24,000	$45,000
Travel/Per Diem		1,500	3,000	5,000	9,500
Supplies		500	1,000	1,500	3,000
Misc.			1,000	1,500	2,500
Total		**$8,000**	**$20,000**	**$32,000**	**$60,000**

AMPHIBIAN AND REPTILE INVENTORY

Abstract

During winter 2000-2001, the Greater Yellowstone inventory coordinator will finalize a contract with Dr. Charles Peterson, Idaho State University, to conduct targeted species surveys, repeat historic surveys, and conduct systematic surveys for amphibian and reptile presence/absence, and limited distribution and abundance data for Bighorn Canyon National Recreation Area, Grand Teton National Park, and Yellowstone National Park. Three-year inventories will be conducted at the network parks, to be completed by 2003. Survey and sampling methodology designs will strongly complement ongoing collaborative GYN investigations (Patla and Peterson 2000) externally funded by the Department of the Interior's Amphibian Research and Monitoring Initiative (ARMI).

Principal Investigator

Dr. Charles Peterson, Idaho State University

Background

Amphibian and reptiles have suffered global population declines, range reductions, and extinction in recent years (Stebbins and Cohen 1995, Alford and Richards 1999). Throughout North America, amphibian declines have been noted within the past decade. Even within relatively pristine western United States landscapes such as national parks, declines of several species of amphibians have also been documented within the past decade (Drost and Fellers 1996, Corn et al. 1997). Documenting "absence" is regarded as extremely difficult for herpetofauna (Fellers 1997); survey results are influenced by many factors including survey intensity and locations, environmental conditions (e.g., drought) affecting animal behavior and observation success, and low population levels. Within the three parks of the Greater Yellowstone Network, documentation of occurrence and distribution of amphibians and reptiles has generally occurred only with opportunistic funding (e.g., Federal Highways NEPA compliance). In all three parks, these opportunistic surveys for presence/absence occurred primarily since 1985 (Patla and Peterson 2000).

Goal

Given the recent regional declines noted above, it is a priority objective of the Greater Yellowstone Network to reestablish benchmark amphibian and reptile presence/absence information.

Objectives

1. Targeted species surveys – Document presence of all amphibian and reptile species that were known or expected to have occurred in the network

parks based on habitat or historic records, but for which currentsubstantiated records are lacking.

2. Repeat historic surveys – Survey the presence of the amphibian and reptile species of concern that were known to have occurred, based on previous surveys in the network parks, but for which current documentation on presence or distribution is lacking.

3. Systematic surveys – Document species presence/absence and distribution and abundance in habitats that have not been previously sampled or were undersampled due to remoteness.

4. Identify critical habitats – Document, through surveys described above and by directed investigations, breeding sites and the locations of key overwinter dens (hibernacula) for which current records are lacking. Note: This objective is also listed in Appendix A as a network priority that is not attainable with expected funding levels.

Project Sampling Strategy

Objectives 1 and 2: The sampling strategy for amphibian and reptile species is to utilize standard visual encounter methodologies (Thoms et al. 1997) at non-randomly selected habitat-based "Special Inventory Sites" (SIS). These SIS will represent high-probability habitats based on known or expected habitat types and will be non-randomly selected based upon historic records or GIS-based habitat mapping. It is expected that between five to ten SIS per park unit would provide adequate benchmark presence/absence to the 90th percentile objective. Due to a general lack of historical species information at Bighorn Canyon, more extensive surveys may be required to provide adequate benchmark presence/absence information to the 90th percentile objective.

Objective 3: Yellowstone will be divided into 10km x 10km grids; at Grand Teton and Bighorn Canyon, 5km x 5km grids will be used. Every third grid will be selected from a randomly selected starting grid. Within each selected grid, all 7th level watersheds will be identified, and a single watershed will be randomly selected and will represent a sampling unit. In the event that the selected watershed contains no evident potential habitat, another watershed unit will be randomly selected. Within each 7th level watershed unit sampled for amphibians, reptile presence/absence surveys will also be conducted when potential reptile habitat exists. Data will be collected at each site using standard field forms. Variables collected at all sites will include date, observers, location, weather, time spent searching, standard habitat indicators, water temperature, pH, conductivity, and species observed, including number of different life stages. Individual adult and juvenile amphibians will be counted and number of larvae will be estimated

based on small area counts and extrapolation.

Objective 4: In addition to documenting amphibian breeding sites encountered during the above surveys, snake hibernacula will be located using implanted radio-transmitters and following subjects to the den site. Areas for investigation will be based on survey results and historical documentation. Emphasis will be placed on locating areas susceptible to disturbance by human activities.

Selection of sampling areas will be constrained by logistics, such as lack of trail access or remoteness, and grizzly bear management area closures. Surveys of remote wilderness drainages will require special procedures, such as base camps, horse packing of gear, and possibly larger survey crews. In the first year of the study, areas sampled will be those that are accessible on day-hikes, e.g., within eight kilometers of a parking area or trailhead.

Surveys will be conducted following standard amphibian visual encounter methodology (Thoms et al. 1997). Within the selected areas, we will search all potential amphibian breeding habitat, e.g., ponds, beaver impoundments, stream oxbows, and pools in moist or wet meadows. Stream and lake edges will be search for dispersed adults, but the primary focus will be the identification of breeding sites. In large apparently uniform wetlands or willow bottoms, we will sample representative areas or search along transects. For example, a survey in such an area could concentrate on several (e.g., 5-10) 50 by 50 meter areas scattered throughout the reach, or be conducted along a linear transect, one on each side of the stream, with placement of the transect determined in the field to intersect with the most likely amphibian breeding sides. Data will be recorded at each site using standard field forms. A “site” will be defined as a discrete potential amphibian breeding area or an aquatically-connected cluster of areas. Sampling areas are expected to host multiple sites. Variables collected at all sites will include date, observers, location, weather, time spent searching, species observed, including number of different life stages, standard habitat descriptors, water temperature, pH, and conductivity. Individual adult and juvenile amphibians will be counted and number of larvae will be estimated based on small-area counts and extrapolation.

Because of the short field season (eight weeks maximum, mid-June to early/mid-August) and distances involved, multiple visits to selected reaches will not generally be practical. However, reaches including riverine habitat where toads may breed later in the season should be re-surveyed if the initial survey occurs prior to mid-July.

Partnership Opportunities

Inventory efforts will expand on and complement activities funded through the Amphibian Research and Monitoring Initiative under the Department of the Interior. Current ARMI funding directed at the Greater Yellowstone Area amounts to $48,000 (Idaho State University, Principal Investigator Dr. Charles Peterson). The current ARMI-Greater Yellowstone initiative does not include Bighorn Canyon National Recreation Area.

Implementation Plan

Field efforts will be conducted under the direction of Dr. Charles Peterson and the Greater Yellowstone Network inventory coordinator. Individual network parks will support activities by providing logistical support such as boat transportation and use of backcountry facilities as available. Field activities will occur over three field seasons (2001 - 2003) in order to provide adequate time for survey efforts and to allow for some annual environmental variability which may affect sampling conditions and population/distribution parameters. Dr. Charles Peterson of Idaho State University has initiated these surveys at Yellowstone National Park and Grand Teton National Park with external funding from the Department of the Interior's Amphibian Research and Monitoring Initiative.

Products

This project will generate an updated presence/absence list of reptile and amphibian species occurring in each of the GYN parks that reflects the servicewide target of 90% completeness. The principal investigator will provide annual reports, a final report, Arcview GIS themes, and an MS Access database of all information collected during the project stored on CD media. The GIS themes will document the locations and habitat characteristics of each species. The MS Access database will include data that documents each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens (when practical) or detailed photographs will be collected for any newly identified species or species with marginal documentation in accordance with the guidelines in documentation section. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The principal investigator will provide metadata in accordance with FGDC standards.

Project Costs

Amphib/Reptile Inventory	FY01	FY02	FY03	FY04	Total
Salary	$22,000	9,400	8,200		$39,600
Travel/Per Diem	4,500	1,900	1,600		8,000
Supplies	2,500	1,200	1,200		4,900
Misc.					
Total	**$29,000**	**12,500**	**11,000**		**$52,500**
DOI ARMI Project Systematic Surveys GRTE/YELL	$24,000	$24,000			$48,000

INVENTORY OF MAMMALS AT BIGHORN CANYON NATIONAL RECREATION AREA

Abstract

The most current inventory completed for mammals in Bighorn Canyon is nearly 15 years old, lacks adequate documentation for 32% of the species included in the inventory list, and is missing common mammal species that should be found in Bighorn Canyon. Completion of this inventory will complement the bat and amphibian and reptile inventories also proposed in this study plan. With this information, Bighorn Canyon will be able to reach the servicewide goal of 90% presence/absence for vertebrate species. This inventory will be conducted through the use of a sole source justification for non-competitive procurement. A template of the form will be completed by the Greater Yellowstone Network steering committee representative from Bighorn Canyon prior to January 2002.

Principal Investigators

Doug Keinath, Wyoming Natural Diversity Database
Paul Hendricks, Montana Natural Heritage Program

Background

The most recent inventory of mammal species in Bighorn Canyon took place in 1985 and includes 67 species in the final report (Patterson 1985). Of these 67 species, 46 species (68%) are documented and 21 species (32%) are included based on range maps in Findholt et al. (1981) and Hoffman and Pattie (1968).

This information, along with habitat type descriptions and general information concerning Bighorn Canyon, was presented to a panel of scientists during the May 2000 Greater Yellowstone Network inventory workshop. These persons included Rick Jannett of the University of Minnesota, Doug Keinath of the Wyoming Natural Diversity Database, Glenn Plumb of Yellowstone National Park, Mason Reid of Grand Teton National Park, and Martina Keil of Bighorn Canyon National Recreation Area. Most notable to all present was the lack of documentation for many species on the list. Many of the undocumented species are relatively common and verification is needed. There are also species that have a very high probability of occurrence in Bighorn Canyon and do not appear on the list of mammals. Results of the workshop show Bighorn Canyon is below the servicewide target of 90 percent presence/absence completion for mammalian species. Based on the list from the 1985 inventory, Bighorn Canyon is approximately 70 percent complete for the presence/absence of mammal species. It has been suggested

that the lack of common species on the list further diminishes confidences in its completeness.

Goal

Gain baseline information on mammal species by fulfilling the servicewide goal of 90 percent presence/absence information for mammals in Bighorn Canyon National Recreation Area.

Objectives

General mammal survey – Document mammal species (excluding bats) presence/absence based on mammals adequately documented during the inventory, mammals included in the list but not documented, and other species that were not included on the list but should be present.

Project Sampling Strategy

The following is a general description of the sampling strategy approach for this inventory. Year one and two will follow this strategy in order to account for year-to-year variation. Initially, a grid-cell approach was considered. Consultation with researchers led to the determination that this approach would be less productive for a presence/absence inventory than a more specific sampling stratified by habitat. Habitats may be targeted for increased or decreased sampling efforts, based on the lists of mammals for Bighorn Canyon, quality of documentation for species, current knowledge of presence/absence for certain species, probability of finding certain species, and the absence of expected species from the Bighorn Canyon lists. If sampling methods require certain consideration (i.e., electricity), these areas will be selected separately from the above. Based on pre-existing rejection criteria, areas may be excluded from sampling (i.e., steep cliffs). Mechanical sampling methods (i.e., pitfall traps, hair snares) that would be necessary to adequately sample will be determined and used.

Partnership Opportunities

This project will complement the bat and amphibian/reptile inventories proposed in the GYN study plan by adding to the 90 percent presence/absence completeness desired.

The inventory coordinator will explore the possibility of using the same contractor for this survey and the proposed bat inventory. This may be viable if said contractor can demonstrate bat experience sufficient to ensure a successful bat inventory. Additional funding, through the bat inventory, will be available to the contractor to include bat sampling strategies and any increase in field time as necessary.

If contractors for the general mammal and bat surveys are different, any incidental documentation will be noted and made available for individuals

conducting each inventory.

Implementation Plan

The Greater Yellowstone inventory coordinator and the steering committee will issue a request for proposals. Contracted personnel will be responsible for organizing any resource material that exists outside of Bighorn Canyon. Bio-techs, under the direction of the inventory coordinator and in cooperation with Bighorn Canyon staff, will assist contracted personnel with organization of in-park resource materials. Field activities necessary to survey the targeted areas will be completed over two field seasons. Contracted personnel will conduct fieldwork under the direction of the inventory coordinator and the Greater Yellowstone Network steering committee. Bighorn Canyon will provide logistical support (transportation by boat to remote areas, camping spaces, etc.).

This project will take place over two years. There will be approximately 18 weeks each year of field time and three weeks of non-NPS data organization.

Deliverables

This project will generate an updated presence/absence list of mammal species occurring in Bighorn Canyon National Recreation Area that reflects the servicewide target of 90 percent completeness. The principal investigator (to be determined) will provide annual reports, a final report, Arcview GIS themes, and an MS Access database of all information collected during the project stored on CD media. The GIS themes will document the location of each species. The park is especially interested in the locations of rare species, species in fragile habitats, and species occurring in areas that are likely to be impacted by human activities. The MS Access database will include data that documents each sampling event, such as sampling date, field person, site location, site description, species name, and species abundance. Voucher specimens (when practical) or detailed photographs will be collected for any newly identified species or species with marginal documentation in accordance with the guidelines in the documentation section. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The principal investigator will provide metadata in accordance with FGDC standards.

Project Costs

Mammal Inventory (BICA)	FY01	FY02	FY03	FY04	Total
Salary		$10,000	$10,000		$20,000
Travel/Per Diem		5,500	5,500		11,000
Supplies		1,000	1,000		2,000
Misc.		2,500	2,500		5,000
Total		**$19,000**	**$19,000**		**$38,000**

INVENTORY OF YELLOWSTONE AND SNAKE RIVER CUTTHROAT TROUT

Abstract

This is a one-year project to include fish species sampling in the upper Snake River basin in Grand Teton and Yellowstone national parks. This project is budgeted for $35,000, with deliverables to include lists of fish species and abundance, along with geo-referenced data on occurrence that can be compared with historic range information.

Principal Investigator

To be determined

Background

The federal land managers in the Greater Yellowstone Area and Wyoming Game and Fish Department have expressed concern about the status of the Yellowstone cutthroat trout (*Oncorhychus clarki bouvieri*) subspecies in the upper Snake River basin, including streams within Yellowstone, Grand Teton, and the Bridger-Teton National Forest (Varley and Gresswell 1988). This concern is related to the possible listing of the Yellowstone cutthroat trout as threatened under the Endangered Species Act. Historic data exist, but no recent surveys in the Snake River have been performed, and there is concern about the relative abundance of game vs. non-game fish, and the relative status of Snake River (*O. clarki* subsp.) cutthroat populations in these streams. There is a need to collect current inventory information on both native cutthroat trout populations and other fish species (native and introduced) in the Snake River drainage (Kiefling 1978).

Goal

The primary aim of this targeted inventory is to establish the current status of native cutthroat trout in the upper Snake River basin in two national parks.

Objectives

1. Targeted species survey: The objective of this survey is to document presence/absence of native cutthroat trout in this particular drainage.

2. Historic survey: This survey has the added objective of comparing the current species assemblage (game and non-game fish) with historic records in the upper Snake River basin of Wyoming (Hudelson et al. 1983).

3. Spatially display geographic distribution of species in the upper Snake River basin.

Project Sampling Strategy

This one-time survey will make use of the following methods: electrofishing, angling, and snorkeling. Standard NPS/USFS methodology for presence/ absence surveys will be used on the Snake River and tributaries throughout Yellowstone and Grand Teton national parks. Distribution of sampling sites will be according to survey methodology as described in *Guidelines for Biological Inventories*. At each sample point, presence/ absence information will include all fish species. Sampling intensity will be based on stream length. Basic habitat information will be recorded at each sample point.

Partnership Opportunities

In 2000-2001, the Aquatic Resources Center in Yellowstone will conduct surveys of cutthroat trout in the Madison and Gallatin watersheds, in collaboration with researchers at Montana State University. The inventory coordinator will work with these researchers to coordinate methods and compare survey results.

In performing these surveys of cutthroat trout, Yellowstone and Grand Teton will work closely with the Bridger-Teton National Forest and the Wyoming Game and Fish Department in the planning and implementation phases. It is likely that the Forest Service will provide leveraged funds for surveying that portion of the Upper Snake River basin on the Bridger-Teton National Forest. Fisheries biologists from Wyoming Game and Fish Department will provide expertise and field assistance during this survey.

Implementation Plan

This activity will be coordinated by the Greater Yellowstone Network inventory coordinator. During one field season (FY04), a complete survey of the upper Snake River basin will be conducted using personnel from the parks, the Forest Service, and the Wyoming Game and Fish Department. Fieldwork will be accomplished by hiring park seasonals and by the use of interagency agreements with the Forest Service and state of Wyoming.

Deliverables

This project will generate an abundance and distribution map of Yellowstone cutthroat trout and Snake River cutthroat trout in the upper Snake River basin of Yellowstone National Park, Grand Teton National Park, and Bridger-Teton National Forest. The principal investigator will provide a final report, Arcview GIS themes, and an MS Access database of all information collected during the project stored on CD media. The final report will include a comparison with historical surveys conducted in the upper Snake River basin. The GIS themes will document all species found,

along with the distribution, population size, and habitat characteristics of Yellowstone cutthroat trout and Snake River cutthroat trout . The MS Access database will include data that documents each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens and/or detailed photographs will be collected for any newly identified species or species with marginal documentation in accordance with the guidelines in the documentation section. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The principal investigator will provide metadata in accordance with FGDC standards.

Project Costs

The one-year survey will cost $35,000 for work in the two parks, with leveraged funds provided by the Forest Service to do stream reaches within the Bridger-Teton National Forest.

Cutthroat Trout Inventory	FY01	FY02	FY03	FY04	Total
Salary				$21,000	$21,000
Travel/Per Diem				4,000	4,000
Supplies				9,000	9,000
Misc.				1,000	1,000
Total				**$35,000**	**$35,000**

INVENTORY OF FISH IN ALPINE LAKES IN GRAND TETON NATIONAL PARK

Abstract

Fish in alpine lakes in Grand Teton National Park have not been surveyed for more than sixty years. These lakes will be surveyed to determine the species compositions over three short field seasons. The surveys will be contracted and will cost $10,000.

Principal Investigator

An interagency cooperative agreement with the Bridger-Teton National Forest and the Wyoming Game and Fish Department

Background

Grand Teton National Park contains more than 25 named lakes in the alpine zone, and numerous others without names. Fish can be found in some of these lakes, however due to differing environmental constraints, the species composition of these lakes is expected to be quite different from lower elevation waters where most sampling has taken place. Only a few alpine lakes have been investigated, and these were sampled over 60 years ago (Hazzard 1931). Many environmental changes have occurred since then, including global climate change, increases in local and regional airborne pollutants, etc., which affect the physical and biological characteristics of these high elevation waters. Thus, species sampling completed sixty years ago do not reflect current conditions. Extinctions may have occurred, and new, perhaps non-native, species may be present and may threaten native species.

Goal

Verify and expand the species list of fishes by surveying under-sampled habitat.

Objective

Inventory alpine lakes to determine their species composition.

Project Sampling Strategy

Sampling will occur during the ice-free period, August through September. Lakes to be sampled will be targeted based on the following characteristics: 1.) They possess a history of containing fish populations; 2.) They have a constant water exchange and connectivity to another water suspected of containing fish; and 3.) They appear to have adequate depth to provide overwintering habitat and have adequate invertebrate life.

Sampling will occur for at least one overnight period per lake. A single 5' x

125' multiple mesh sinking gill net will be employed. The net will contain five panels of differing mesh sizes, 0.5-1.5", with the panels oriented from small to large mesh.

Partnership Opportunities

Wyoming Game and Fish Department manages sport fisheries in Grand Teton. Most sampling and management efforts are directed toward the low-land lakes containing salmonid sport fisheries. The U.S. Forest Service is currently inventorying streams on Forest Service lands adjacent to the park to determine the distribution of both the Yellowstone and Snake River cut-throat trout. Tissue samples for DNA analysis are being collected by both Wyoming Game and Fish and the Forest Service to determine species identification and the degree of purity of strain.

Implementation Plan

Field crews will be contracted under an interagency (Wyoming Game and Fish/U.S. Forest Service) agreement and directed by the network inventory coordinator. A two-person crew will investigate alpine lakes during the short (about four weeks) ice-free period during the summer. Due to the short period when work can be accomplished, three field seasons are required to provide adequate time to sample. Access will be by foot, and will require methods and skills appropriate for use in remote backcountry areas. Logistical support will include lake shuttles and use of backcountry cabins.

Deliverables

This project will generate an updated presence/absence list and distribution maps of fish species occurring in the alpine lakes of Grand Teton National Park. The principal investigator will provide annual reports, a final report, and an MS Access database of all information collected during the project stored on CD media. The principal investigator will work with the inventory coordinator to create ArcView GIS themes that document the location, abundance, and habitat characteristics of all fish and amphibian species found during the survey. The MS Access database will include data documenting each sampling event, such as date, field person, site location, site description, species name, and species abundance. Voucher specimens and/or detailed photographs for any newly identified species or species with marginal documentation will be provided in accordance with the guidelines in the documentation section. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The GYN coordinator will create metadata in accordance with FGDC standards

Project Costs

GRTE Alpine Lakes	FY01	FY02	FY03	FY04	Total
Salary	$2,500	$2,000	$2,000		$6,500
Travel/Per Diem	500	500	500		1,500
Supplies	1,000	500	500		2,000
Misc.					
Total	**$4,000**	**$3,000**	**$3,000**		**$10,000**

BALD EAGLE AND SAGE GROUSE SURVEYS IN GRAND TETON NATIONAL PARK

Abstract

Aerial surveys will be performed for bald eagles and sage grouse to allow for monitoring and protection of these species. Existing park staff will be used, and flights will occur over three years and will cost $5,000.

Principal Investigator

Mason Reid, Project Biologist, Grand Teton National Park

Background

Bald eagles are a threatened species under the Endangered Species Act of 1973. Grand Teton National Park has been active in monitoring bald eagles within its boundaries since the early 1970s (Swenson et al. 1986). However, attrition of nest structures, as well as staffing constraints, have limited the park's ability to locate and monitor nest sites. Over the last several years, information on at least three (30%) of the ten known territories has not been collected because nest structures could not be located, and so monitoring has not been effective.

Sage grouse have experienced declines throughout the West, and are under petition to be listed under the Endangered Species Act. In Grand Teton, monitoring efforts using lek counts have shown 75 percent declines in attendance of known leks in an area without impacts commonly associated with declines in other regions. One concern with the lek counts is the possibility that other leks may exist undetected, and so surveys may not accurately reflect population trends. No surveys for new leks have been performed since the 1950s (Patterson 1952), and recent monitoring efforts have centered on leks discovered during that time.

Goal

The goal of the proposed effort is to identify sites for sensitive bird species that will allow protection of these sites and continued monitoring.

Objectives

1. Locate and document bald eagle nest sites to allow accurate assessment of population trends.

2. Locate and document sage grouse leks to allow accurate assessment of population trends.

Project Sampling Strategy

Bald eagles: Known and historic eagle territories will be annually surveyed using helicopters during incubation (early April). Once nest sites are located, they will be monitored through existing park monitoring programs. Although fixed-wing aircraft are used for monitoring (see Partnership Opportunities below), helicopters are required to locate unknown nests due to their slower airspeeds and improved visibility.

Sage grouse: Aerial line transects of low-elevation sagebrush habitat will be surveyed using fixed-wing aircraft during the lekking period (April – early May). Once leks are located, they will be monitored through existing park monitoring programs.

Partnership Opportunities

Grand Teton currently maintains an active monitoring program for both bald eagles (territory occupancy and productivity) and sage grouse (counts of birds occupying known leks). On an annual basis, the Wyoming Game and Fish Department performs nest occupancy surveys of known bald eagle nests in the Greater Yellowstone Area using fixed-wing aircraft. In areas peripheral to the park, Wyoming Game and Fish performs sage grouse lek counts using fixed-wing aircraft in order to assess populations for harvest. In addition, a study of the ecology of sage grouse in Grand Teton is in its second year (Holloran 2000). This study is supported by Grand Teton National Park and by the Wyoming Cooperative Research Unit through the University of Wyoming. The goal of the study is to document nesting success and sage grouse winter range in an effort to understand the observed declines in the local population.

Implementation Plan

Existing park staff will perform surveys as part of their normal duties. Both fixed-wing and rotor-winged aircraft are available locally, and local pilots have extensive experience with wildlife surveys. Surveys for both species will be performed once yearly. Further monitoring efforts are included in existing monitoring programs. Additional effort for sage grouse will be needed in the first year of the project since area-wide surveys have not already been completed and additional areas would need to be covered.

Deliverables

This project will generate abundance and distribution maps for bald eagles and sage grouse in Grand Teton National Park. The principal investigator will provide annual reports, a final report, and an MS Access database of all information collected during the project stored on CD media. The principal investigator will work with the inventory coordinator to create ArcView GIS themes of nesting sites and lek locations that document the abundance, distribution, and habitat preferences of each species. The MS Access database

will include data that documents each sampling event, such as date, field person, site location, site description, species name, and species abundance. Detailed photographs will be collected of nesting and lek sites. This documentation will include information on the time of collection, location, collector, and site notes. The GYN coordinator will ensure that project findings are updated in the servicewide biological databases including NPSpecies, ANCS+, Natural Resource Bibliography, and the Dataset Catalog. The GYN coordinator will create metadata in accordance with FGDC standards.

Project Costs

Bald Eagle and Sage Grouse Inventory	FY01	FY02	FY03	FY04	Total
Salary					
Travel/Per Diem					
Supplies					
Misc. - Helicopter	$1,000	$1,000	$1,000		$3,000
- Fixed Wing	1,000	500	500		2,000
Total	**$2,000**	**$1,500**	**$1,500**		**$5,000**

VII. DATA MANAGEMENT

The Greater Yellowstone Network's plan for managing data addresses five topics: 1.) Documenting data that already exist; 2.) Assessing existing data and converting the most important datasets into more useful formats; 3.) Ensuring that new data are collected, stored, and documented in such a way that data are not lost, are easy to access, and have the best chance of being used; 4.) Making data, and the information generated by the data, accessible to park staff, scientists, and the public; and 5.) Ensuring that data management strategies designed for these inventory efforts survive beyond the current funding initiatives.

Existing Data

Hundreds of thousands of dollars have historically been spent on collection of disparate datasets in the three parks. The Greater Yellowstone Network is using these data to determine which species are known to occur in each of the parks. Unfortunately, none of the three parks have complete, well-organized records of all the data. Without good documentation, studies are forgotten and data are lost. Some of the pre-proposal funding provided to the Greater Yellowstone Network was used to search out and document the most critical datasets, species occurrence records, and bibliographic references for all three parks. Those records have been entered into the Dataset Catalog, NPBIB, and NPSpecies as described below. A GS-5 seasonal technician is currently collecting records for these databases and will continue this data mining until early March of 2001. A GS-5 term technician will be hired in March to continue these efforts throughout FY01 and into FY02. In addition, a GS-7 GIS Technician will spend 11 weeks in FY01 cleaning up existing spatial layers and converting the most important historic databases into GIS coverages.

The Greater Yellowstone Network is using the Dataset Catalog to document existing datasets. The Dataset Catalog is an MS Access-based relational database that stores information (metadata) about datasets rather than storing the datasets themselves. The Dataset Catalog stores information about GIS layers, digital spreadsheets, satellite imagery, paper field notebooks, and any other form a dataset might take. Using pre-proposal money, 420 datasets from Bighorn Canyon, Grand Teton, and Yellowstone were entered into this database. The network's first priority was to search for data that supported the inventory efforts identified as highest priority in the May, 2000 workshop. This information was needed to complete this study plan and will be a valuable reference for the Coordinator. The network's goal is to have all the important datasets for vertebrates and vascular plants recorded in the Dataset Catalog by the end of FY01We are locating datasets by three methods, 1) interviewing people who have a lot of experience working with vascular plants and vertebrates in the Greater

Yellowstone Area, 2) reviewing Investigators Annual Reports for all three parks, and 3) searching bibliographic databases. Because of the large volume of existing data, though, the process of documenting datasets will continue throughout the inventory process. The Greater Yellowstone Network will continue to update the database with new datasets as they are created.

Species records have been entered into NPSpecies, another MS Access-based relational database, designed to document species occurrences and the evidence to back up each record. Using pre-proposal funds, the Greater Yellowstone Network has entered 1168 (410 vertebrates + 758 vascular plants) records for Bighorn Canyon, 363 (363 vertebrates + 0 vascular plants) records for Grand Teton, and 1714 (421 vertebrates + 1293 vascular plants) records for Yellowstone. The Grand Teton vascular plant records are stored in the ANCS+ database. A technician is currently converting these 3,500 records, representing 1,000 different species, from ANCS+ to NPSpecies. With the exception of vascular plant information for Grand Teton, all known vascular plant and vertebrate species occurrences have at least one entry. There are records for each park that need more complete information about park status, abundance, nativity, etc. The appropriate expert will review these records in FY01. Many of the entries still need information about voucher specimens, references, or reliable observations. We are currently reviewing Yellowstone's ANCS+ records from the Yellowstone herbarium and museum, and adding relevant information about voucher specimens to NPSpecies. A GYN technician will visit the four main herbaria (University of Montana, Montana State University, Rocky Mountain Herbarium, and Idaho State University) between December and March of FY01 to search for records from the three parks. We will also conduct computerized searches of national museums and herbaria for park records of vertebrate and vascular plant occurrences. Yellowstone's botanist, Jennifer Whipple, will review all vascular plants records for accuracy. Wildlife specialists at the three parks will review the vertebrate records. These voucher records will then be added to NPSpecies. Our goal in FY01 is to locate known voucher specimens, detailed photographs, or reliable observations and add some piece of evidence to every entry. The database will continue to be updated as we discover new information.

Bibliographic reference information resides in a number of locations, such as online databases, local computers, card catalogs, and the reference sections of reports. One goal of this inventory effort is to consolidate and update all relevant bibliographic records into one database. The Natural Park Bibliography (NPBib), a ProCite-based database, is the servicewide database of bibliographic information. In September, park staff added entries for all three parks bringing the total number of records in NPBIB up to 438 records for Bighorn Canyon, 1,086 records for Grand Teton, and 10,028 records for Yellowstone. At this time, the Dataset Catalog and NPSpecies aren't linked with NPBIB, so every entry in these databases with a tie to a bibliographic record must be manually cross checked with records in NPBIB. At some time in the future, these three databases will be linked and

this extra step won't be necessary. During FY01, NPBib records for all three parks will be updated and the inventory coordinator will ensure bibliographic references in NPSpecies and the Dataset Catalog are compatible with entries in NPBIB.

The inventory coordinator is responsible for understanding the data management tools (NPSpecies, the Dataset Catalog, and NPBIB) well enough to administer the periodic updates from the I&M Program, troubleshoot problems, design custom reports, and train technicians to enter new data, query the database, and create reports. We are currently using GS-5 level technicians to interview people, track down information about existing data sources, and enter the information into the appropriate database. In March of 2001 we will hire a term GS-5 technician to continue these efforts and begin to convert the most important datasets.

Assessing and Converting Existing Data

The Dataset Catalog is an excellent tool for prioritizing datasets. The inventory coordinator will prioritize the data conversion based on which data will be the most useful to the inventory process. The conversion must be designed so that the new data can be used (and analyzed) with the existing data. This will include converting data on paper into digital data, creating new GIS layers of point observations, creating new GIS layers of potential habitat, changing the format of existing digital data, and fixing errors. All data conversion will include either an entry in the Dataset Catalog or the completion of FGDC compliant metadata. Most data conversions involve more grunt work than sophisticated techniques, so in the majority of cases a competent technician is able to complete the task. The GYN hires technicians with GIS and database experience who also have a background in field botany and/or wildlife management.

Incorporating the New Data

It will be the responsibility of the inventory coordinator to ensure that all new species records, datasets, and bibliographic information created during the inventory process are entered into the appropriate database. All contracts and cooperative agreements will be written with this as a requirement. If park personnel are involved in new inventories, they will have the same requirements. Both the coordinator and the technicians will receive metadata training to ensure that all GIS databases created during the inventory process have FGDC compliant metadata. This training will include other park staff when appropriate.

A relational database will be created in MS Access to store all the GYN sampling data created during the inventory process. The design of this database uses the I&M Database Template as a base. The template has a core database structure that we can modify to hold information about bats and other mammals, reptiles, amphibians, fish, birds, and vascular plants. Information needed by all projects, such as personnel, site, and program data, will be stored in shared tables. Each sampling event will be recorded in the appropriate program table (amphibians,

reptiles, mammals, alpine plants, etc.), that will be designed to store information unique to those taxa. The program tables will be linked to the shared tables so that all common information is similar between different programs.During FY01, the inventory coordinator will work with a database consultant to create this new database. To facilitate complete data collection, standardized data forms that cue investigators to record pertinent data in an appropriate sequence will be developed. Where appropriate, the Access databases will include standard "report" formats for printing field forms, complete with sample site coordinates and attributes. Money has been budgeted for approximately 60 hours of a consultant's time for initial development and 75 more hours for modifications and troubleshooting. The coordinator must understand the database design and be able to modify the structure, customize queries, and create reports. Depending on the project, contractors or Greater Yellowstone Network technicians will do the actual data entry. The database will be designed so that stand-alone parts can be given to contractors and returned to the coordinator after they have been populated.

Making the Information Accessible

The information in Greater Yellowstone Network Dataset Catalog, NPSpecies, and NPBIB databases will be available at each park and also through the I&M Program's suite of Internet databases. GIS databases, except when sensitive information is involved, will be available through Montana State University's Greater Yellowstone Data Clearinghouse and the University of Wyoming's Data Clearinghouse. Data clearinghouses provide searchable access over the Internet for spatial data.

The NPS Theme Manager (formerly called the GIS Data Browser) and other custom extensions have already been incorporated into the Yellowstone GIS Program. These tools are being tested and will soon become part of the GIS operations in Bighorn Canyon and Grand Teton. The Theme Manager provides an easy interface for viewing and manipulating spatial information for people who have limited training in GIS. It is limited to computers that already have ArcView installed.

The GYN is also experimenting with Synthesis as an information management system for efficiently locating, organizing, integrating, and disseminating data and information. Synthesis organizes and provides easy access to a variety of data and information formats. Topics are arranged in outline form, similar to how MS Explorer displays drives, folders, and file names for a personal computer. The program allows different types of data (text-based documents, photographic libraries, databases, spreadsheets, presentation graphics, geographic information system (GIS) data, bibliographies, Internet-based information, and decision support systems) to be grouped together under a common heading. Access is as easy as "clicking" on a title. As long as the computer has a software package that can read the data, the user can view the information. All of the databases discussed in this section, including the NPBib, NPSpecies, Dataset Catalog, GIS Theme Manager, and

the MS Access I&M Database Template, can be accessed through Synthesis. Synthesis will allow all levels of park staff easy access to inventory information.

Ensuring Data Management Survives

It is important that the databases, information, and data management skills developed during the three-year inventory process continue to be useful to park management after the inventories are complete. The databases will continue to be used and populated if park staff believe that they are useful and understand how to use them. Park staff in program areas outside of the current inventory focus must be trained and encouraged to use each of the databases. The databases should be highlighted and explained when the inventory coordinator updates park staff and managers on the progress of the inventory. The NPS Theme Manager should be installed on all computers with ArcView. Training must be provided on using Synthesis to access inventory information.

Budget for Coordinator and Data Management

The coordinator has been hired and will begin working in January of 2001 and work full-time through FY04. The term GS-5 technician will be hired in March of FY01, work through FY02, and 6 months of FY03. A seasonal GS-5is working from mid-November of through early March of FY01. In FY04 a GS-5 technician will be hired for 4 months to assist the coordinator in finishing the inventory. A GS-7 GIS Technician will work for 11 weeks in FY01 on GIS data for the inventory. The database creation money will be used to hire a database consultant.

Data Management	FY01	FY02	FY03	FY04	Total
Coordinator (GS-11/4 Term)[1]	$49,500 (20)	$68,500	$71,000	$73,500	$262,500
Technician (GS-5 Term)[1]	18,400 (15)	25,400 (20)	17,700 (13)		61,500
Technician (GS-5 Seasonal)[2]	8,800 (9)			8,700 (8)	17,500
Technician (GS-7 Seasonal)[2]	6,700 (5.5)				6,700
Travel and Training	10,000	5,000	3,000	3,000	21,000
Supplies and Equipment	12,600	2,000	2,000	2,000	18,600
Database Creation and Maintenance	5,000	2,000	2,000	2,000	11,000
Total	**$111,000**	**$102,900**	**$95,700**	**$89,200**	**$398,800**

Note: Numbers in parenthesis indicate the number of pay periods.

[1]Includes 35% benefits, 4% cost of living increase each year, and step increase each year

[2]Includes 7.5% benefits, 4% cost of living increase each year

VIII. DOCUMENTATION

Voucher/herbarium specimens will be collected for all new vascular plant species encountered during the inventory in accordance with the collections policies as outlined in *NPS Management Policies*, "Museum Objects and Library Materials"; "Security and Protective Measures"; "Preservation of Data and Collections and Protection of Research Potential", and NPS-77, *Natural Resource Management Guideline*. Voucher specimens will be cataloged in ANCS+ and NPSpecies and made available over the Internet to be accessed by individuals with permission to do so.

The vouchers will be placed in the respective park's herbarium.

Vertebrates will be documented with verified written records by taxonomic authorities or voucher photographs. Records or photographs will include the scientific name of the vertebrate, all important diagnostic features, date and location of photograph or observation, and name of observer or photographer. Copies of voucher photographs will be deposited in the respective park's archives.

Animals found dead may be saved for vouchers or museum display, depending upon the wishes of the park in which they were found and availability of funding from that park.

APPENDIX A: UNFUNDED PROPOSALS

The following projects were identified by subject-matter experts at the Greater Yellowstone Network's workshop in Bozeman and by park managers. This is not, however, intended to be a comprehensive list of unfunded natural resource management projects.

A description of each unfunded project follows.

Project	*Estimated Amount*
Neotropical Birds at BICA, GRTE, and YELL	*150,000*
Additional Non-Native Plant Surveys at BICA, GRTE, and YELL	*100,000*
Alpine Plants at GRTE and YELL	*75,000*
BICA Cougar Distribution and Abundance	*75,000*
Small Mammal (Shrews and Voles) Surveys in GRTE and YELL	*40,000*
Whitebark Pine Blister Rust Studies - GRTE and YELL	*30,000*
Peregrine Surveys at GRTE	*20,000*
Inventory of Micro-Habitats at BICA	*10,000*

Neotropical Birds at Bighorn Canyon, Grand Teton, and Yellowstone

Bighorn Canyon National Recreation Area and Grand Teton and Yellowstone national parks host many neo-tropical migratory bird species during breeding and migration seasons. They depend on many habitats and travel widely (thousands of miles) during their annual migration. Many ornithologists consider them to be at risk since not all areas and habitats are protected and there is evidence of population declines in some species. Parks, since they are relatively pristine, can provide comparative data in broad-scale monitoring programs, allowing researchers to determine whether population declines are caused by problems on the breeding grounds. The parks in the Greater Yellowstone Network have no quantitative baseline population information on these species. Completing a quantitative survey will allow the parks to understand the current status and distribution of migratory birds within the parks and to design long-term monitoring programs.

In 1990, due to concern over apparent declines in neo-tropical migratory bird populations and their habitats on the wintering and breeding areas and along migration routes, the National Park Service and more than a dozen other federal agencies and many more non-governmental organizations signed a memorandum of understanding to conserve them. These groups formed "Partners in Flight" to facilitate research and monitoring, education, and regional workgroups to foster conservation of these species. Baseline surveys in the Greater Yellowstone

Network will be coordinated with Partners in Flight cooperators, particularly the Western Working Group and Monitoring Working Group.

Project Cost: $150,000

Alpine Plants in Grand Teton and Yellowstone National Parks

Most of the vascular plant studies conducted in Yellowstone National Park have been concentrated on areas relatively easily accessible from roads. Because of this, alpine areas have received little attention. With additional funding, inventories similar to the alpine plant study in the Gallatin Range (see page 51) would be conducted in the Two Ocean Plateau and southern Absaroka mountain areas, two other major alpine areas within Yellowstone.

Two Ocean Plateau/Big Game Ridge Region: The Two Ocean Plateau/Big Game Ridge area is predominantly composed of sedimentary rocks, unlike the volcanic rhyolites and andesites that dominate the Yellowstone landscape. Botanical surveys in this area have been very limited and apparently primarily restricted to the vicinity of the trail system due in part to the long distance from any road.

Southern Absarokas: The southern portion of the Absaroka Range in Yellowstone has been largely neglected from major botanical surveys even though mountains such as the Trident have fairly extensive areas of high-elevation vegetation. Access is complicated due to this area being one of the most distant regions from any road in the lower-48 states, resulting in incomplete botanical survey of this area.

Few studies of vascular plants in the alpine areas of Grand Teton National Park have been conducted. While various researchers have compiled species lists of these areas, there is no record of an inventory being completed in the more inaccessible regions. Due to the international reputation of this area for climbing sports, there is also the possibility of alpine species from other regions being introduced.

Climbing routes, high saddles, and accessible meadows should be inventoried. A more comprehensive inventory would require personnel with technical climbing skills.

Project Cost: $75,000

Bighorn Canyon Cougar (*Felis concolor*) Distribution and Abundance

Two populations of bighorn sheep (*Ovis canadensis*) in California have declined to low densities as a result of mountain lion (*Felis concolor*) predation. The resident bighorn sheep population in Bighorn Canyon is experiencing a dramatic decline in numbers. Current hypotheses surrounding the cause of this decline in Bighorn Canyon include an increase in the mountain lion population and a subsequent increase in sheep predation. Current research being conducted by the USGS is exploring the declining sheep population in the park. Knowledge of the abundance and distribution of mountain lions in and around Bighorn Canyon would complement the current research, increasing the effectiveness of wildlife management actions in the park.

Project Cost: $75,000

Complete Inventory of Small Mammals at Yellowstone and Grand Teton National Parks.

Although the list of mammal species in Grand Teton and Yellowstone national parks are believed to be at least 90% complete, it is likely there are certain small mammal species found in the parks that have not been identified. These would include certain vole species and certain species of shrews (such as *Sorex vagrans*). Some of these species, such as the water shrew (*Sorex palustrus*), may serve as indicators of water quality and overall ecosystem health. Targeted small mammal surveys conducted during one field season at Grand Teton and another field season at Yellowstone would provide more information about these species. This survey project could be coordinated with the "Inventory of Mammals at Bighorn Canyon National Recreation Area," one of the projects to be funded as part of the GYN biological inventories. The principal investigator for both parks could be a researcher from a university or a state natural heritage program, and field crews would be provided by the parks.

Project Cost: $40,000

Whitebark Pine Blister Rust Surveys

The whitebark pine (*Pinus albicaulis*) is a keystone species in the subalpine areas of Yellowstone and Grand Teton national parks. It represents one of four major food sources for grizzly bears, and poor whitebark cone crops result in increased human-bear conflicts with associated bear mortality. The whitebark pine is also an important tree species for red squirrels, Clark's nutcrackers, and other wildlife,

and is central for hydrologic function. The whitebark pine blister rust, a fungus introduced from Europe in 1910, infects whitebark pine and causes high tree mortality. Studies have shown that the blister rust has reached epidemic proportions, and is now decimating subalpine white pines in the northern Rocky Mountains. Recent research has documented blister rust at low levels in the two parks, and suggests that the incidence is increasing. These surveys have been somewhat limited in scope, and more expansive surveys are warranted to more fully document the extent of blister rust infection with the ultimate goal of protecting the ecosystem from its effects.

Project Cost: $30,000

Peregrine Falcon Surveys, Grand Teton National Park

As part of a region-wide NRPP effort, Grand Teton National Park initiated extensive peregrine falcon surveys in 1990 and 1991. Despite a considerable amount of effort, no new territories were discovered, and the park contained only a single eyrie, discovered in 1988. Although no generalized surveys have been performed since 1991, three new eyries have been discovered in the park, providing strong evidence for an expanding population. One eyrie was located in a popular canyon near a rock climbing area, and use restrictions have been necessary for two years to protect the site. Considering the extensive climbing use of Grand Teton and the potential for conflicts with peregrines that occupy cliff areas, additional surveys are needed to locate and protect peregrine falcon nesting sites.

Project Cost: $20,000

Inventory of Plant and Animal Species Abundance and Distribution in Side Canyon Micorhabitats of Bighorn Canyon NRA.

Current and future habitat improvement projects in Bighorn Canyon will be conducted in areas where infrequent micro-habitats occur. These micro-habitats significantly differ from the relatively large surrounding habitat types. Casual observations by resource personnel indicate the presence of plant and animal species that have not been documented in the adjacent habitat types. In order to make sound management decisions regarding the manipulation of these important micro-habitats, a comprehensive inventory of species utilizing these areas is needed.

Project Cost: $10,000

APPENDIX B: PRE-PROPOSAL

Note: *The following is the pre-proposal as submitted to the NPS Inventory and Monitoring Program on December 12, 1999. $62,000 was awarded to the GYN in FY00.*

Introduction. This pre-proposal outlines the approach to be used by the three parks that comprise the Greater Yellowstone network to complete the initial steps for conducting biological inventories of vertebrates and vascular plants as described in the "Guidelines for Biological Inventories" (NPS 1999a). The purpose of this pre-proposal is to describe how the three parks will work together to complete the steps up to and including the development of a detailed study plan for inventorying the vertebrates and vascular plants in the parks. The initial steps include (1) doing an inventory of existing data sources and organizing and compiling existing data; (2) identifying data gaps and determining priorities and the level of detail required for additional field sampling; and (3) development of the full study plan that will describe the spatial sampling strategy and methodology for collecting additional information, as well as the products to be generated by the inventories.

General Setting and Resources. The three parks in the Greater Yellowstone I&M network include Bighorn Canyon National Recreation Area (BICA), Grand Teton National Park (GRTE), and Yellowstone National Park (YELL).

Bighorn Canyon NRA (BICA-62,353 acres) is located in north central Wyoming and south central Montana between the Pryor Mountains to the west and the Bighorn Mountains to the east. Steep elevation and precipitation gradients, geologic and topographic diversity, and the presence of Bighorn Lake create a mosaic of unique ecosystems that are home to many vascular plant and vertebrate species (Lichvar et al. 1985, Knight et al. 1987). The extensive areas of calcareous substrate that occur scattered throughout the canyon and Pryor Mountain foothills support an array of plant species and communities endemic to the region. Plant and animal species of special concern for both Montana and Wyoming including many endemic plants have been documented in these diverse plant communities (Lichvar et al. 1985, Patterson 1985, Knight et al 1987, Worthington 1991).

Adjacent lands administered by the Bureau of Land Management (BLM), U. S. Fish and Wildlife Service (USFWS), Wyoming Game and Fish (WYGF) and Crow Indian Tribe (CIT) provide a continuation of similar habitats. Portions of the Pryor Mountain Wild Horse Range (PMWHR) and the Yellowtail Wildlife Habitat Management Area (YWHMA) exist within BICA. Animal species in the area often seasonally use these lands and depend on the natural ecosystem attributes existing in BICA for survival.

Historic land use impacts are becoming less apparent, and although grazing and livestock trailing still occur in BICA, this use is minimal compared to many adjacent public and private lands. The absence of heavy commercial and terrestrial recreational use adds to the importance of BICA as a haven for diverse flora and fauna. BICA's floral and faunal treasures are vast, but to date have been relatively unexplored. Many of the available inventories are in need of updates and reinvestigation to become relevant to the current management objectives at BICA. Little is known about the occurrence and distribution of many vascular plant species and the residence status of many vertebrate animal populations (Worthington 1991).

Grand Teton National Park (GRTE-310,521 acres) was established in 1929 to protect the Teton Range, and was expanded in 1950 to include much of the valley named Jackson Hole. Jackson Lake (25,540 acres) and the Snake River dominate Jackson Hole, and the Grand Teton (13,770 ft.) towers 7,000 feet above the valley floor, providing the elevational contrast for which the park is noted. Deep, glacially carved canyons cleave the mountains, and several canyons have large, morainal lakes at their mouths. Associated with the diverse topography is a diversity of natural communities. Sagebrush and lodgepole pine dominate the lower elevations, giving way to spruce-fir forests, whitebark pines, and finally bare rock in the alpine zone. Willow flats border Jackson Lake, and riparian and cottonwood gallery forests border the Snake River. The 1959 expansion of the park added parts of many areas that had been traditionally or are still being actively ranched with subsequent effects and impacts to the native plant and animal communities. The John D. Rockefeller, Jr. Memorial Parkway (JODR- 23,773 acres) is administered by GRTE and provides a physical link between GRTE and YELL. Both areas contain world-wildlife resources, including grizzly bears, gray wolves, and one of the largest elk herds in the world.

Yellowstone National Park (YELL-2.2 million acres) was established as the world's first national park in 1872. Ninety-eight percent of the park remains undeveloped, providing a wide range of habitat types that support one of the continent's largest and most varied native large mammal populations. Natural resource management focuses on preserving the components and processes of naturally evolving ecosystems. Yellowstone ranges in elevation from 5,282 to 11,358 feet, and contains several broad volcanic plateaus and parts of three mountain ranges. The spectacular geothermal systems scattered throughout Yellowstone lead to extreme temperature gradients in water and soil with resultant impacts on plant, animal and microbial communities. Approximately 80% of the land is forested. The park consists of five fairly distinct vegetation zones influenced most heavily by the interaction between geology and climate (Despain 1990). Four of the five zones are at higher elevations ranging between 6,500 and 11,000 feet, are underlain by bedrock of volcanic andesite or rhyolite origin, and receive precipitation ranging from 20 to 70 inches annually. These areas generally support forests dominated by lodgepole pine, Engelmann spruce, subalpine fir, and/or whitebark pine interspersed with subalpine meadows or alpine tundra above timberline. The remaining zone, primarily along the Yellowstone and Lamar River valleys in the northern portion of

the park, encompasses approximately 9%of the total park area. This-low elevation zone (5,200 to 6,500 ft) is underlain by glacial debris of volcanic andesite and sedimentary composition and receives only 11-20 inches of precipitation annually. As a result, the area is dominated by sagebrush shrublands and grasslands and is the zone most susceptible to exotic plant invasion and establishment. The park's vegetation mosaic provides habitat for a wide range of megafauna including bison, elk, moose, grizzly bears, black bears, mule deer, white-tailed deer, bighorn sheep, pronghorns, mountain lions, coyotes, and gray wolves. Yellowstone's aquatic habitats, including Yellowstone Lake and many trout-bearing streams, are also important features of the park's landscape. A special feature of the current landscape is the extensive area (793,889 acres) that was burned in fires that occurred in 1988.

Together, GRTE and YELL represent the core of the Greater Yellowstone Ecosystem, which supports the greatest wildlife show in the temperate zone of North America. BICA complements this as an outlier of the Greater Yellowstone Ecosystem representing additional plant and animal communities unique to the Pryor and Bighorn mountains and of the central Rocky Mountains in general. Each park is refuge for some of the most diverse and interesting plant and animal species the National Park Service administers for the enjoyment of future generations. Tables 1 summarizes a preliminary review of inventory datum for vascular plants and vertebrates.

Preliminary List of Park-Specific Objectives for Biological Inventories. The three Greater Yellowstone parks contain many sensitive, threatened, and endangered vascular plants and animals while alien plants and vertebrates represent important threats to remaining native biota.

Within the boundaries of BICA exist endemic, threatened, sensitive and special concern vascular plant and vertebrate species, as well as representations of the ecosystems necessary for the persistence of these species. BICA's bighorn sheep population is in a period of decline and the data on our mule deer population is not as complete as for other large ungulates in the park. Population viability studies of the Pryor Mountain wild horse population suggest a possible need for future expansion of the range. BICA has recently begun a wildlife habitat improvement project to address these issues. Updated inventories of the plant and animal species in BICA would provide better information on which to base more comprehensive management decisions when implementing the phases of this project as well as future projects. Little is known about the occurrence of inconspicuous plant and animal species. The extensive calcareous substrate throughout the area is colonized by endemic and globally rare species creating unique plant communities. Calcareous charged springs and seeps have not been extensively surveyed and may support globally rare plant and animal species. Previous inventories have recorded occurrences of vertebrates whose distribution is limited to Wyoming and Montana or that are considered rare in these states (Patterson 1985, Redder 1986, and Worthington 1991). Multi-seasonal inventories would create a more complete picture of vertebrate species occurring in BICA. Although some of these animal species do not reside year round in BICA, it is necessary to include

them into management plans. The Bighorn and Shoshone rivers, feeding Bighorn Lake, act as vectors for alien plant species that threaten the natural processes of BICA's ecosystems and the persistence of native plants and animals. Old-growth cottonwood forests present in prime riparian habitats throughout BICA are being threatened by alien species. Inventory and mapping of alien plant species would improve BICA's weed eradication program by giving us the ability to monitor the spread of existing species, evaluate management activities, recognize new invasions, and document the persistence of native plant species.

Grand Teton contains several threatened species, including gray wolves, grizzly bears, bald eagles and the soon-to-be-listed lynx. Amphibians have shown declines, but sampling has been minimal and needs expanding. Inventories of small mammals and landbirds are preliminary and incomplete. Fisheries resources are popular to the public, but a current inventory does not exist. The number of exotic plant species is at least 115, and it appears to be growing with visible effects on native plant populations. Our current plant inventory list is incomplete and contains errors; many areas of the park have never been inventoried for plants especially areas remote form trail systems and roads.

The fundamental goals of YELL's resource management program are outlined in the YELL Resource Management Plan (YNP 1995) and are underpinned with the purpose of allowing natural processes and interactions between resources to occur with a minimum of human influence. The YELL Master Plan (YNP 1973) and Statement for Management (YNP 1991) state that all public and administrative use and development decisions must be based on sound resource management practices and the best available data; and that an effective program of protection, preservation, management, interpretation, and public use of the park's natural resources be established and maintained based on data obtained through appropriate inventory, monitoring, and research. While there has been a long tradition of vertebrate and vascular plant ecological research at YELL, there has been little compilation across the hundreds of such investigations to generate master inventory lists that capture species richness, abundance or distribution. Of specific importance is the extent of exotic vascular plant species within existing developed area footprints as well as the degree of exotic species invasion into undeveloped park terrestrial and aquatic backcountry. The aquatic systems of YELL support extensive native and exotic fisheries upon which numerous predator and scavenger vertebrates depend. The richness, abundance and distribution of aquatic vascular flora that underpins these systems are poorly described as well. There also exists a need to comprehend the complexity of extreme YELL habitats such as high elevation lakeshore, alpine talus slopes and geothermally influenced areas that support small populations of rare and sensitive vascular plant species uniquely adapted to such habitats. The extent of small vertebrate prey richness, abundance and distribution is also poorly documented in the face of a extensive and largely intact pre-European predator guild. Due to the extensive pristine landscapes of YELL, there remains a need to document the richness, abundance and distribution of regionally rare vertebrates and vascular plants including meso-fauna such as bats and small rodents.

Inventory Team. The Greater Yellowstone Inventory and Monitoring Network will establish a steering committee made up of representatives from each of the three parks, with Dr. Kathy Tonnessen, Research Coordinator for the Rocky Mountain CESU, as chair. This committee will make decisions on funding allocation, contracting, and prioritization of needs, and will work with an extended planning committee comprised of selected park staff and experts chosen from the Montana Natural Heritage Program and Wyoming Natural Diversity Database program, The Nature Conservancy, USGS/BRD, and appropriate universities. Contact information for key individuals is shown in Table 2.

Strategy for Initial Planning and Study Plan Development. The Steering Committee has already participated in a series of conference calls to outline our strategy for selecting regional experts to assist in compiling existing data and writing the full proposal. The development and completion of the Biological Inventory Study Plan will result from (1) a Steering Committee scoping meeting in late-January 2000; and (2) an inventory study plan workshop in early-March 2000 that will finalize study plan objectives and (3) writing assignments completed by to the extended planning committee by June 2000.

Scoping Meeting. Staff from the three parks have begun to summarize information on past inventories and to provide information to the steering committee. This will help provide briefing materials for an initial Steering Committee scoping meeting to be held in Bozeman, MT during late-January 2000 and will help the group set priorities for additional inventories. Briefing materials will include: (1) management needs for each park, based on statements from enabling legislation, statements from the Master Plans, GMPs and RMPs, interviews with the superintendents and natural and cultural resource managers, and input from key park user groups and scientists familiar with the park; (2) consideration of the stressors and threats to park resources; (3) consideration of the types of management activities currently being conducted in each park and the types of information needed from biological inventories as they relate to park management; and (4) consideration of data gaps identified from an initial summary of past work.

Study Plan Workshop. Bi-weekly conference calls among the Steering Committee will occur during January and February to facilitate communication and progress leading up to a Greater Yellowstone Network Biological Inventory study plan workshop to be held in Riverton, Wyoming in early March, 2000. The study plan workshop will bring together the Steering Committee and the extended planning committee with appropriate selected experts chosen from the Montana Natural Heritage and Wyoming Natural Diversity Database programs, USGS/BRD, The Nature Conservancy and academia. The goal of the three day Workshop is to clarify issues using a variation of the Adaptive Environmental Assessment methodology (GeoWest 1992) by bringing specialists together for brief periods of intense interaction focused on predefined system objectives. Participants will include a mix of modellers, research scientists, resource managers, and database managers. The facilitated workshop will begin with introduc-

tions of study areas to identify project objectives, existing data (inputs), "problem bounding", and anticipated performance indicators (outputs). The workshop will include a series of brainstorming sessions based on the identification of critical subsystems and components of the Biological Inventory with initial breakout sessions determined by domain expertise. It is expected that the interaction and interest generated by this workshop will provide significant opportunities to define, enhance and generate a full Biological Inventory Study Plan for the Greater Yellowstone Network within the predetermined time frame.

Information Compilation and Synthesis. In addition to having current staff compile existing information and management needs, we will use the partial funding from the I&M program to hire two staff from an appropriate institution to geographically reference existing information on vascular plant and vertebrate surveys in a GIS format. We will use the Dataset Catalog (NPS 1999b, NPS 1999c) to summarize existing information stored in various formats (e.g. convert NPFlora, NPFauna lists to NPSpecies). Conversion of these data to NPSpecies databases developed for servicewide application will allow export of locational data and other information from voucher specimens and observations to park- or network-based GIS. These data compilation and synthesis tasks will continue for two or more years, but the initial steps will help us identify data gaps, prioritize data needs, stratify each park for sampling purposes, and integrate data from inventories of the various taxa (vascular plants, mammals, birds, reptiles and amphibians, and fish).

Budget. Partial funding to prepare full study plan:

Direct Costs:

- Data entry technician (GS-5 @ 13 pp)	12,250
- GIS technician (GS-5 @ 13 pp)	12,250 -
Contract to USGS/Universities for data analysis/Study Plan writing	12,500
- Study Plan Workshop facilitator	2,500
- Travel (Park Staff and selected Study Plan Workshop attendees)	12,000
- Supplies	2,500

Indirect Costs:

- Rocky Mountain CESU (15%)	8,100
Total needed for initial steps:	**$62,100**

Milestones.

December 1999: Submit Greater Yellowstone Network Biological Inventory Pre-Proposal

January 2000: Notice of award of initial funding to conduct activities described in Pre-Proposal.

Late January 2000: Initial Steering Committee scoping meeting, Bozeman, Montana.

January – February 2000: Bi-weekly conference calls among Steering Committee and developing extended planning committee. Chair of Steering Committee will hire two staff from an appropriate institution to begin compiling existing inventory information and geographically reference existing information on vascular plant and vertebrate surveys in a GIS format.

Early March 2000: Greater Yellowstone Network Biological Inventory Study Plan Workshop, Riverton, Wyoming.

March – May 2000: Completion of delegated writing assignments by extended planning committee and appropriate selected experts chosen from the Montana Natural Heritage and Wyoming Natural Diversity Database programs USGS/BRD, and academia.

June 2000: First and final drafts of Biological Inventory Study Plan completed.

Deliverables (for preliminary work described by this pre-proposal)

- Summary of existing inventories (expansion of information in Table 1).
- Summary of statements from park legislation, Master Plans, GMPs, RMPs, and interviews with managers and biologists regarding management needs from inventories
- Summary of stressors and threats to park natural resources as they relate to data needs from the I&M program.
- Initial draft of the Dataset Catalog database (in MS Access) used to inventory existing inventory data.
- Initial draft of NPSpecies database, including documentation of existing references and voucher specimens.
- Summary of existing GIS themes for each park.
- Briefing material package to be handed out prior to March 2000 study plan workshop.
- Summary report of study plan workshop.
- Updated natural resource bibliographies.
- Full study plan showing the statistical design, methodology, budget, schedule, and deliverables, for additional biological inventory work.

APPENDIX C: SUBJECT MATTER EXPERTS

Following is a preliminary list of subject matter experts that were identified during the Greater Yellowstone Network's inventory workshop held in Bozeman, Montana.

Vascular Plants

Don Despain, USGS
Bob Dorn, botanical consultant
Walt Fertig, Wyoming Natural Diversity Database
Steve Haynes, Grand Teton NP
Bonnie Heidel, Montana Natural Heritage Program
Mary Hektner, Yellowstone NP
Dennis Knight, University of Wyoming
Peter Lessica, botanical consultant
Stuart Markow, USFS
Kelly McCloskey, Grand Teton NP
Craig McClure, Yellowstone NP
Suzzane Morstad, Bighorn Canyon NRA
Barbara Mullin, Montana Department of Agriculture
Alan Pomery, Bighorn County
Roy Renkin, Yellowstone NP
Peter Rice, University of Montana
Dick Shaw, Utah State University
Roger Sheley, Montana State University Agricultural Extension
Tom Stohlgren, USGS
Teton County, Wyoming
Jennifer Whipple, Yellowstone NP
Tom Whitson, University of Wyoming Agricultural Extension

Mammals

Stanley Anderson, University of Wyoming
Steve Cain, Grand Teton NP
Kerry Foresman, University of Montana
Paul Hendricks, Montana Natural Heritage Program
Rick Jannett, University of Minnesota
Doug Keinath, Wyoming Natural Diversity Database
Martina Keil, Bighorn Canyon NRA
Tom Lemke, Montana Fish, Wildlife, and Parks
Bob Luce, Wyoming Game and Fish
Brian Miller, Denver Zoological Foundation
Tom O'Shea, USGS
Glenn Plumb, Yellowstone NP
Mason Reid, Grand Teton NP

Birds

Mike Britten, NPS Intermountain Region
Steven Fancy, WASO
Terry McEneaney, Yellowstone NP
Susan Patla, Wyoming Game and Fish
Mason Reid, Grand Teton NP

Fish

Mark Gambin, Idaho Fish and Game
Wayne Hubert, University of Wyoming
Ralph Hudelson, Wyoming Game and Fish
John Kiefling, Wyoming Game and Fish
Jeff Kirchner, USFS
Dan Mahony, Yellowstone NP
Mark Novak, USFS
Mike Young, USFS

Amphibians/ Reptiles

Fred Allendorf, University of Montana
Ed Brodie, Utah State University
Steve Corn, USGS
Grant Hoggett, Carroll College, Helena
Deb Patla, Idaho State University
Chuck Peterson, Idaho State University
Andy Sheldon, University of Montana

Data Management/GIS

Joe Gregson, NPS NRID
Dave Hammond, Grand Teton NP
Cynthia Kaag, Washington State University
Bruce Nash, NPS NRID
Marilyn Ostergren, NPS Columbia Cascades Support Office
Ann Rodman, Yellowstone NP
Casey Stewart, Bighorn Canyon NRA
Mark Wotawa, NPS NRID

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